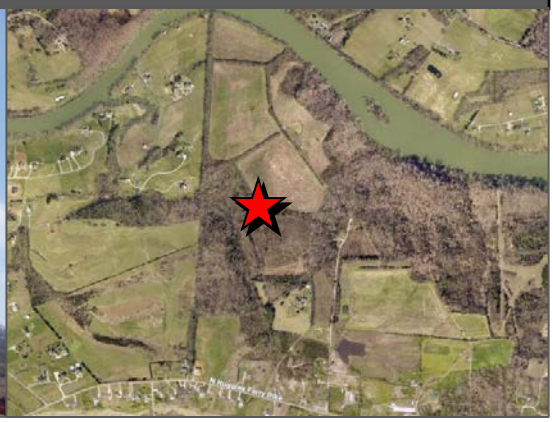
Transportation Impact Study

Innsbruck Farms

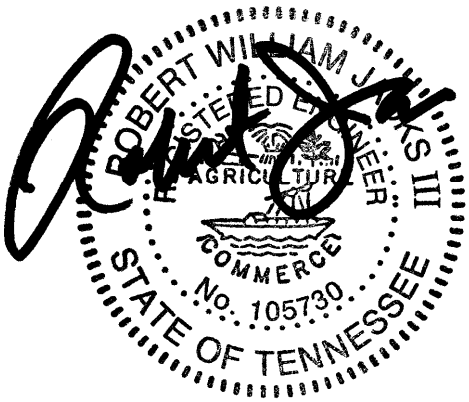
Knox County, Tennessee



Revised February 2021

3-SB-21-C
Revised: 2/26/2021

Prepared for:
RC Ruggles, LLC
10710 Murdock Drive
Knoxville, TN 37932



2/26/2021

11812 Black Road / Knoxville, TN 37932 • (865) 556-0042 • ajaxengineering@gmail.com

EXECUTIVE SUMMARY

Preface:

RC Ruggles, LLC is proposing a residential development north of North Ruggles Ferry Road in East Knox County, TN. The name of this proposed residential development is "Innsbruck Farms", and this development will consist of 482 single-family residential houses on 182.8± acres. This development is anticipated to be fully built-out and occupied by the year 2028. This study's primary purpose is to determine and evaluate the potential impacts of the development on the adjacent transportation system. The study includes a review of the primary access roads and intersections and is a Level 2 study as set forth by Knoxville/Knox County Planning. Recommendations and mitigation measures will be offered where transportation operations have been projected to be below recognized engineering standards.

Study Results:

The findings of this study include the following:

- At full build-out and occupancy, the Innsbruck Farms Subdivision with 482 single-family residential houses is calculated to generate 4,420 trips on an average weekday. Of these trips, 348 are estimated to occur during the AM peak hour and 460 trips in the PM peak hour in the year 2028.
- This development will have two entrances. One entrance will be constructed on North Ruggles Ferry Pike and create a new t-intersection, and one will be at an existing intersection that will be modified at North Ruggles Ferry Pike at Blake Lane. These intersections are projected in future conditions to operate with minimal delays. The two intersection ends of North Ruggles Ferry Pike at Asheville Highway and Andrew Johnson Highway were examined in the study. Both have been calculated to operate with high vehicle delays currently. Without modifications at these intersections, they are also projected to operate very poorly in the year 2028.

Recommendations:

The following recommendations are offered based on the study analyses. The recommendations are offered to minimize the traffic impacts of the proposed development on the adjacent road system while attempting to achieve an acceptable traffic flow and safety level. The recommendations marked with an asterisk indicate an existing transportation need and are not associated with the proposed development's projected impacts.

* • Due to the existing high vehicle delays and meeting traffic signal warrants based on the existing traffic volumes, it is recommended that the intersection of Asheville Highway at North Ruggles Ferry Pike be signalized.

* • It is recommended that the existing sign (R3-2) prohibiting westbound left-turns at the intersection of Asheville Highway at North Ruggles Ferry Pike be replaced with a new sign in the interim and supplemented with additional signage (minimum of 2 additional signs) located on the east side median facing westbound traffic. Once the intersection is re-constructed with a traffic signal, this prohibition can be more pronounced by installing a sign on the span wire (or mast arm).

* • It is recommended that the intersection of Andrew Johnson Highway at North Ruggles Ferry Pike (West Side) be signalized. This recommendation is offered due to the existing high vehicle delays, unfavorable geometric layout of the intersection, and nearly meeting traffic signal warrants for signalization based on the existing traffic volumes. In the year 2022, traffic signal warrants are expected to be fully met, assuming that the subdivision adds approximately 60 homes in the first year of the development.

• During the planning phase for a traffic signal at the intersection of Andrew Johnson Highway at North Ruggles Ferry Pike, it is recommended that the eastbound approach of North Ruggles Ferry Pike be examined whether an exclusive right-turn lane should be provided.

* • It is recommended that the median nose on the north side of the intersection on Andrew Johnson Highway be modified to help facilitate eastbound left turns from North Ruggles Ferry Pike (West Side).

• It is recommended that Stop Signs (R1-1) and 24" white stop bars be applied to the pavement of the Road "A" and Blake Lane/Road "Q" approaches at North Ruggles Ferry Pike. The stop bars should be applied at a minimum of 4 feet away from the edge of North Ruggles Ferry Pike and should be placed at the desired stopping point that maximizes sight distance.

• Intersection sight distance at Road "A" and Blake Lane/Road "Q" must not be

impacted by future landscaping or signage. There is an existing utility pole on the eastern side of the proposed location of Road "A" and a hedgerow on the eastern side of Blake Lane/Road "Q" at North Ruggles Ferry Pike. These existing objects could interfere with sight distance looking towards the east. A licensed land surveyor must verify the available sight distance at these subdivision entrances.

* • A passing zone is currently delineated on North Ruggles Ferry Pike's centerline at the proposed entrance locations. Knox County Engineering should determine whether these passing zones should be maintained once the development is constructed.

- The widening of Blake Lane will require consideration of the pavement interface between the lane and the parking area of an existing church. Pavement striping may be necessary to delineate the roadway from the parking area.
- It is recommended that 25-mph Speed Limit Signs (R2-1) be posted near the front of both streets, Road "A" and Blake Lane/Road "Q", off North Ruggles Ferry Pike. End of roadway signage (OM4-1) should be installed at the western end of Road "B" and the eastern end of Road "R".
- Stop Signs (R1-1) and 24" white stop bars should be installed on the new internal streets, as shown in the report.
- Sight distance at the new internal intersections in the development must not be impacted by new signage or future landscaping. With a speed limit of 25-mph in the development, the intersection sight distance requirement is 250 feet. The stopping sight distance required is 155 feet for a level road grade. The road layout designer should ensure that sight distance lengths are met.
- All drainage grates and covers for the residential development need to be pedestrian and bicycle safe.
- Sidewalks are not proposed for this development. If this changes, they should have appropriate ADA-compliant curbed ramps at intersection corners, and the sidewalks are recommended to be 5 feet minimum in width.
- Traffic calming measures might be needed for this development. Several roads within the development have long and straight road segments. The possible need for traffic calming measures inside the development should be coordinated with Knox County Engineering and Public Works during the detailed design phase.
- All road grade and intersection elements internally and externally should be designed to AASHTO, TDOT, and Knox County specifications and guidelines to ensure proper operation.

DESCRIPTION OF EXISTING CONDITIONS

- **STUDY AREA:**

The proposed location of this new development is shown on a map in Figure 1. The proposed development will be located to the north of North Ruggles Ferry Pike near Burris Road and Blake Lane in East Knox County, TN. The proposed development will comprise twenty-one internal paved roads built for 482 single-family residential houses on 182.8± acres. Transportation impacts associated with the proposed development were analyzed at the following existing roadways and intersections, where the most significant impact is expected and as requested by Knox County Engineering:

- Asheville Highway (US 11E / US 70 / US 25W / SR 9) at North Ruggles Ferry Pike
- Andrew Johnson Highway (US 11E / SR 34) at North Ruggles Ferry Pike (West Side)
- Andrew Johnson Highway (US 11E / SR 34) at North Ruggles Ferry Pike (East Side)
- North Ruggles Ferry Pike at Burris Road

In addition to these existing intersections, the study also includes the review of two subdivision entrances. One entrance will be constructed approximately 565 feet to the west of Burris Road, creating a new t-intersection on North Ruggles Ferry Pike. The development will have a second subdivision entrance via an improved section of Blake Lane at the existing t-intersection with North Ruggles Ferry Pike, approximately 735 feet to the east of Burris Road.

The proposed development property is in a rural, pastoral area of East Knox County, TN. Near this development, there are many single-family residences, unused/woodland properties, farm properties, churches, and a public 18-hole golf course (Ruggles Ferry Golf Course). The proposed site property is undeveloped and currently consists of forested sections and areas for farm production. The site is adjacent and bounded by the Holston River to the north.

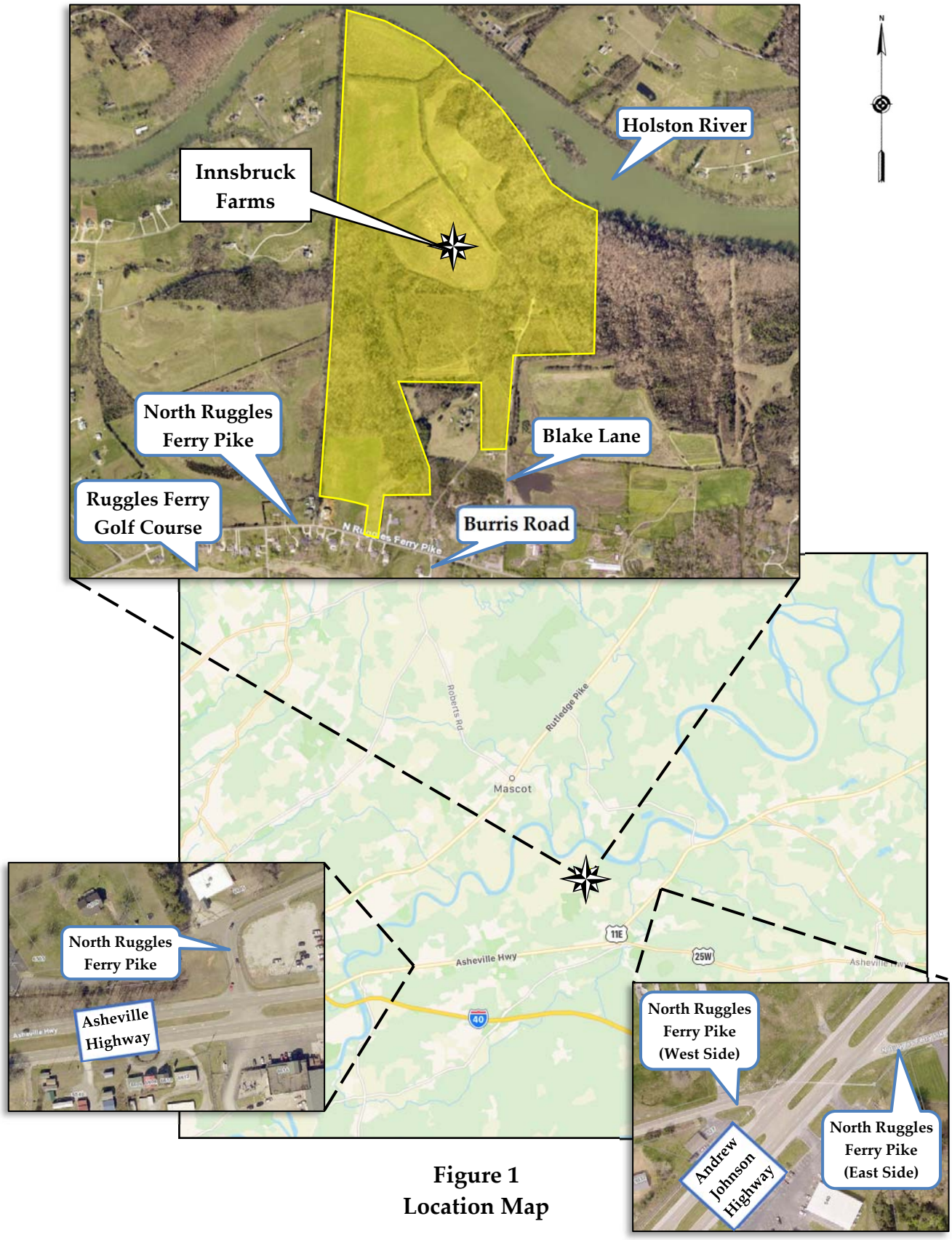


Figure 1
Location Map

- **EXISTING ROADWAYS:**

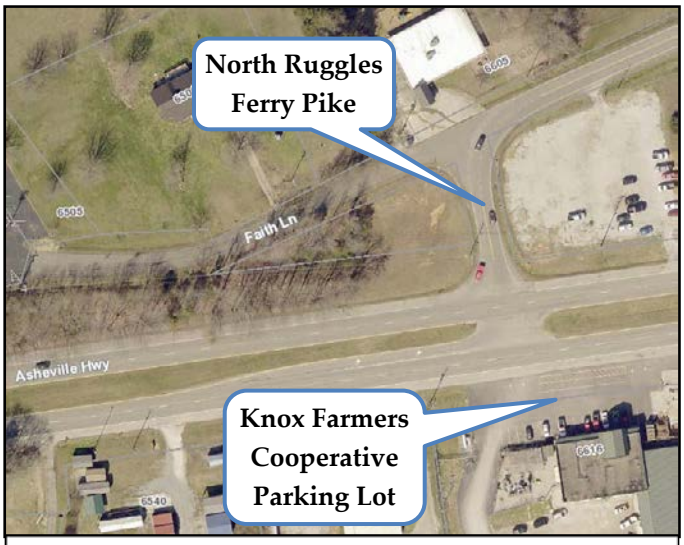
Table 1 lists the characteristics of the key existing roadways adjacent to the development property and included in the study:

TABLE 1
STUDY CORRIDOR CHARACTERISTICS

NAME	CLASSIFICATION [1]	SPEED LIMIT	LANES	ROAD WIDTH [2]	TRANSIT [3]	PEDESTRIAN FACILITIES	BICYCLE FACILITIES
Asheville Highway (US 11E / US 70 / US 25W / SR 9)	Major Arterial	55 mph	4 divided	100 feet	None	No sidewalks along roadway	No bike lanes
Andrew Johnson Highway (US 11E / SR 34)	Major Arterial	55 mph	4 divided	100 feet	None	No sidewalks along roadway	No bike lanes
North Ruggles Ferry Pike	Major Collector	40 mph	2 undivided	23.5 feet	None	No sidewalks along roadway	No bike lanes
Burris Road	Local Street	25 mph / 30 mph	2 undivided	12 feet / 16 feet	None	No sidewalks along roadway	No bike lanes
Blake Lane	Local Street	Not Posted	2 undivided	13 feet	None	No sidewalks along roadway	No bike lanes

[1] 2018 Major Road Plan by Knoxville/Knox County Planning
[2] Edge of curb to edge of curb or edge of pavements near project site
[3] According to Knoxville Area Transit System Map

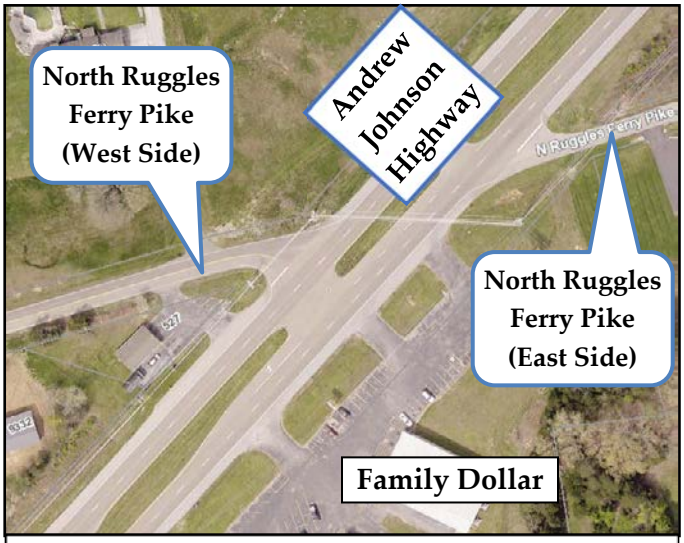
Asheville Highway (US 11E / US 70 / US 25W / SR 9) is a 4-lane major arterial that traverses in a generally east-west direction. According to Wikipedia, US 25W is 145.7 miles in length and runs between Newport, Tennessee, and Corbin, Kentucky. Closer to the study area, Asheville Highway provides convenient access to Knoxville to the west, Jefferson City to the northeast (via Andrew Johnson Highway), and Dandridge to the east. The posted speed limit on Asheville Highway is 55 mph at North Ruggles Ferry Pike.



Asheville Highway at North Ruggles Ferry Pike

At the intersection of North Ruggles Ferry Pike, Asheville Highway is a divided highway with a 30-foot grass median. A separate left-turn lane is provided for eastbound traffic on Asheville Highway for turns onto North Ruggles Ferry Pike. Grooved pavement rumble strips are located just outside the white edge lines on Asheville Highway in both directions. North Ruggles Ferry Pike is controlled by a Stop Sign (R1-1) on the intersection's north side. A private driveway/parking lot area for the Knox Farmers Cooperative is located to the south and directly across Asheville Highway from North Ruggles Ferry Road. The private parking lot spans nearly 300 feet along the south side of Asheville Highway. There are utility street lights on Asheville Highway at the intersection with North Ruggles Ferry Pike. Westbound left-turn movements are prohibited. This prohibition is designated with signage (R3-2) at the end of the west side median at the intersection.

Andrew Johnson Highway (US 11E / SR 34) is a 4-lane road classified as a major arterial that traverses in a general northeast-southwest direction. US 11E is 120.9 miles in length and runs between Knoxville, TN, and Bristol, Virginia. At the intersection with North Ruggles Ferry Pike, Andrew Johnson Highway is a divided highway with a 30-foot grass median and has a posted speed limit of 55 mph. There are no utility street lights on Andrew Johnson Highway at the intersection with North Ruggles Ferry Pike. Utility lights, however, are provided in the adjacent shopping center parking lot.



Intersection of Andrew Johnson Highway at North Ruggles Ferry Pike

A separate left-turn lane is provided for northbound traffic on Andrew Johnson Highway for turning vehicles onto North Ruggles Ferry Pike (West Side). A third northbound lane on Andrew Johnson Highway is provided between the East Side and West Side of North Ruggles Ferry Pike. This extra lane is provided for temporary refuge and room for motorists to accelerate and merge into northbound traffic on Andrew Johnson Highway from North Ruggles Ferry Pike (West Side).

Grooved pavement rumble strips are located just outside the white edge lines on Andrew Johnson Highway in both directions. North Ruggles Ferry Pike on the East side and West side are

controlled by Stop Signs (R1-1). A private driveway/parking lot area for a Family Dollar store is located to the southeast and directly across from North Ruggles Ferry Road (West Side). Andrew Johnson Highway bisects North Ruggles Ferry Pike at a sharp skewed angle with the East Side and West Side approaches of North Ruggles Ferry Pike being separated by approximately 250'.

North Ruggles Ferry Road is a 2-lane major collector and traverses in an indirect east-west direction between Asheville Highway on the west side to Andrew Johnson Highway on the east side. Past Andrew Johnson Highway on the East Side, North Ruggles Ferry Pike continues for an additional 1,125 feet before terminating at a t-intersection with Strawberry Plains Pike. North Ruggles Ferry Pike has a total length of 5.7 miles between Asheville Highway and Andrew Johnson Highway and primarily provides access to single-family homes, farms, and undeveloped properties. The posted speed limit on North Ruggles Ferry Pike is 40 mph, and the roadway is delineated with some sections of passing zones designated with centerline pavement markings. Utility roadway lighting is not provided along North Ruggles Ferry Pike in the vicinity of the proposed development. One of the proposed subdivision entrances for Innsbruck Farms will tie onto North Ruggles Ferry Pike at a t-intersection, approximately 565 feet west of the existing 4-way intersection with Burris Road. Both approaches of Burris Road are controlled by a Stop Sign (R1-1) at the intersection with North Ruggles Ferry Pike.

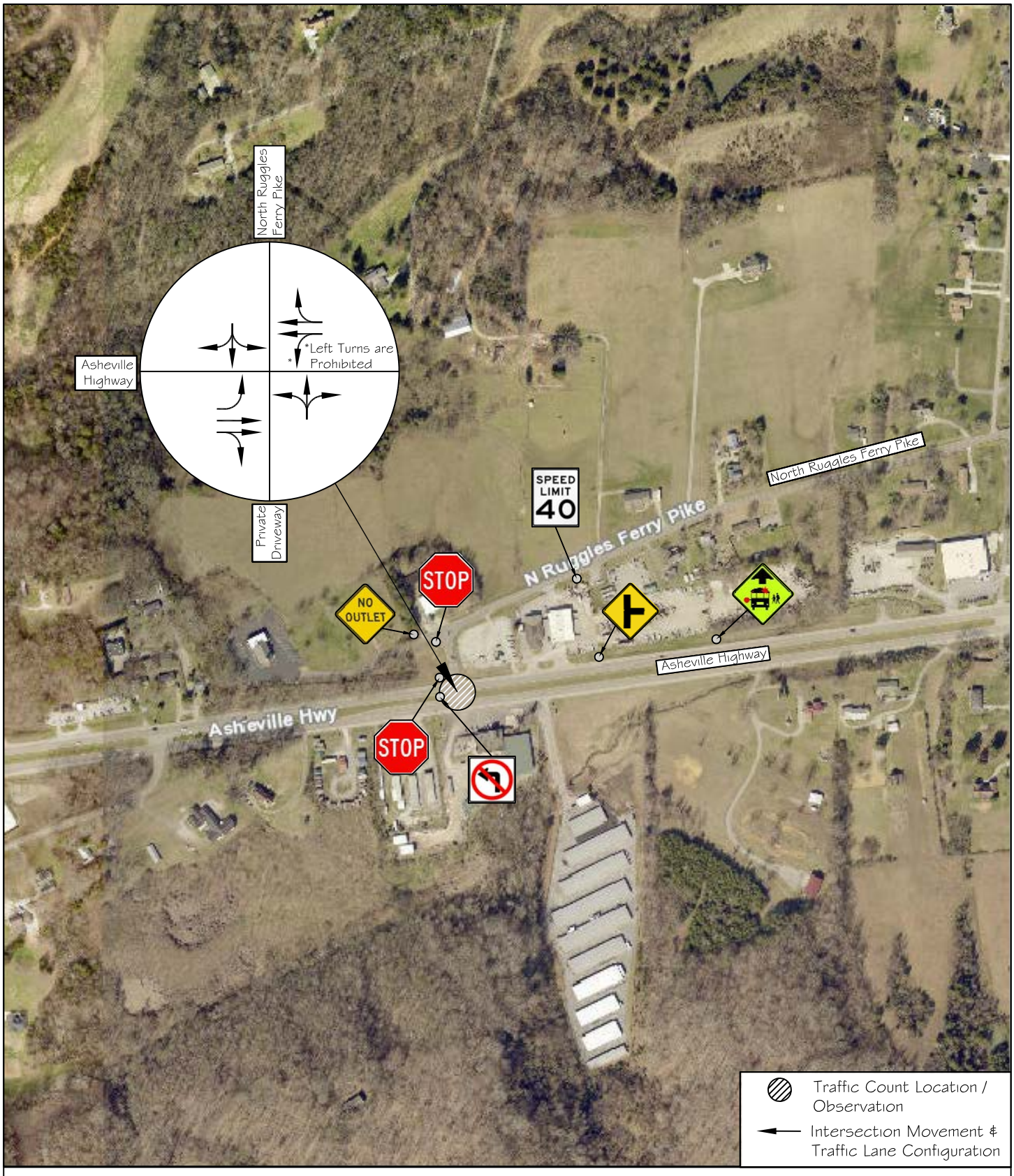
Burris Road is a narrow 2-lane local road and has a posted speed limit of 30 mph to the south of Ruggles Ferry Pike and 25 mph to the north of Ruggles Ferry Pike. Burris Road traverses in a north-south direction and is 0.7 miles in length between North Ruggles Ferry Pike and Pleasant Hill Road to the south. To the north of North Ruggles Ferry Pike, Burris Road narrows in width and provides access to a few single-family homes and vacant properties.

Blake Lane is a narrow local road that runs nearly due north and south and is nearly 2,700 feet in length. It officially ends at a field entrance to a vacant agricultural property. Blake Lane serves access to a handful of properties, including a few single-family homes and large undeveloped properties. Blake Lane is only 13 feet in width, and it intersects North Ruggles Ferry Pike at a t-intersection 735 feet to the east of the intersection of Burris Road. A small church is located on the northwest corner of the intersection of North Ruggles Ferry Pike at Blake Lane, and a portion of the church parking area abuts Blake Lane. Blake Lane is controlled with a Stop Sign (R1-1) at the intersection with North Ruggles Ferry Pike.

In addition to a new subdivision entrance off North Ruggles Ferry Pike to the west of Burris Road, the proposed development will also have a second entrance at North Ruggles Ferry Pike to the east of Burris Road via an improved and widened section of Blake Lane.

North Ruggles Ferry Pike at Blake Lane (Looking North)

Figures 2a and 2b show the lane configurations of the roadways and intersections examined in the study, the study traffic count locations, and traffic signage in the near vicinity. The traffic signage shown only includes warning and regulatory signage. This information is split into two figures due to the large distances between the reviewed intersection locations. The pages following Figures 2a and 2b give an overview of the site study area with photographs.



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

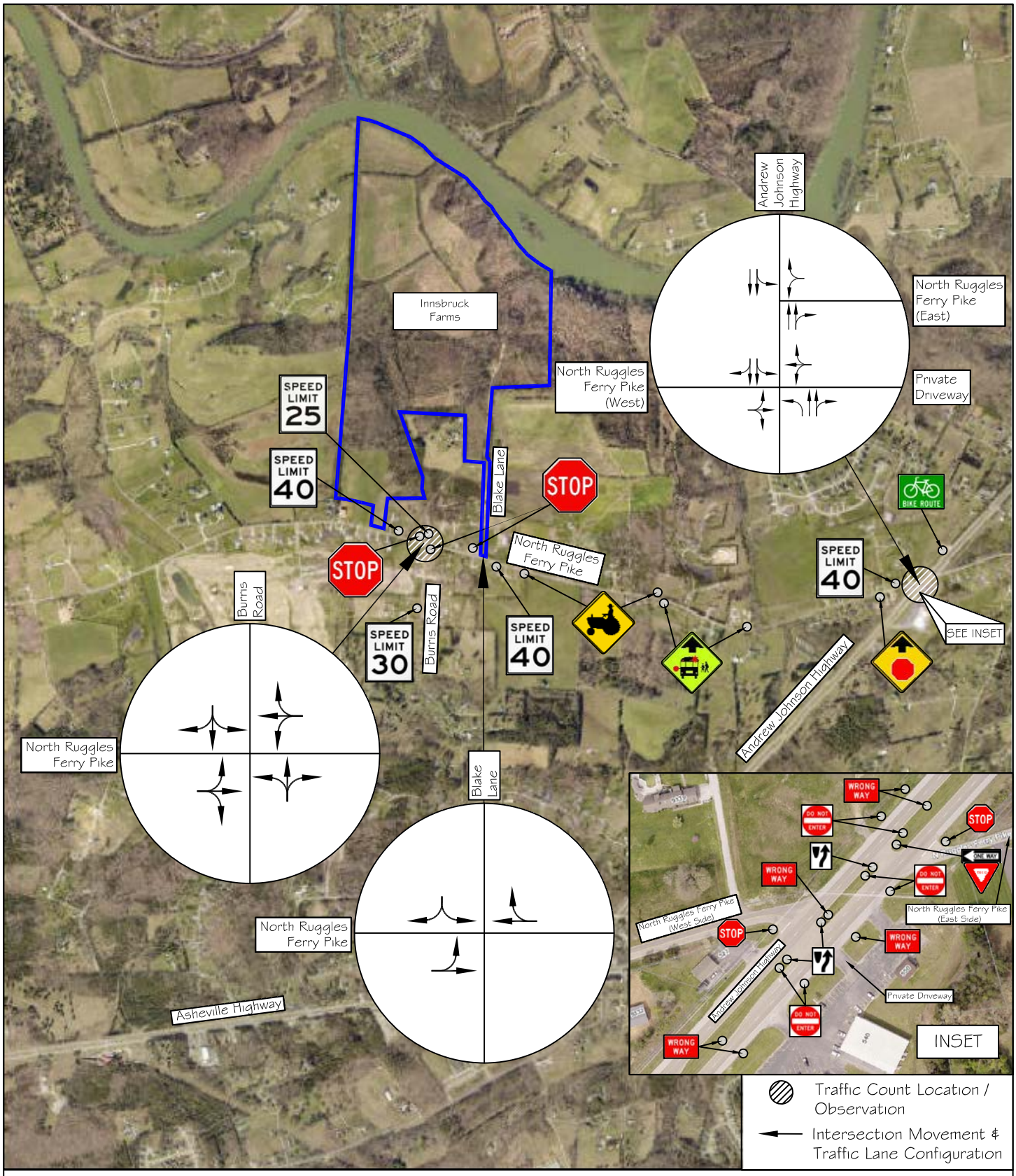
NOT TO SCALE

NORTH

FIGURE 2a

Innsbruck Farms

Traffic Count Locations, Traffic Signage & Existing Lane Configurations



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

NOT TO SCALE

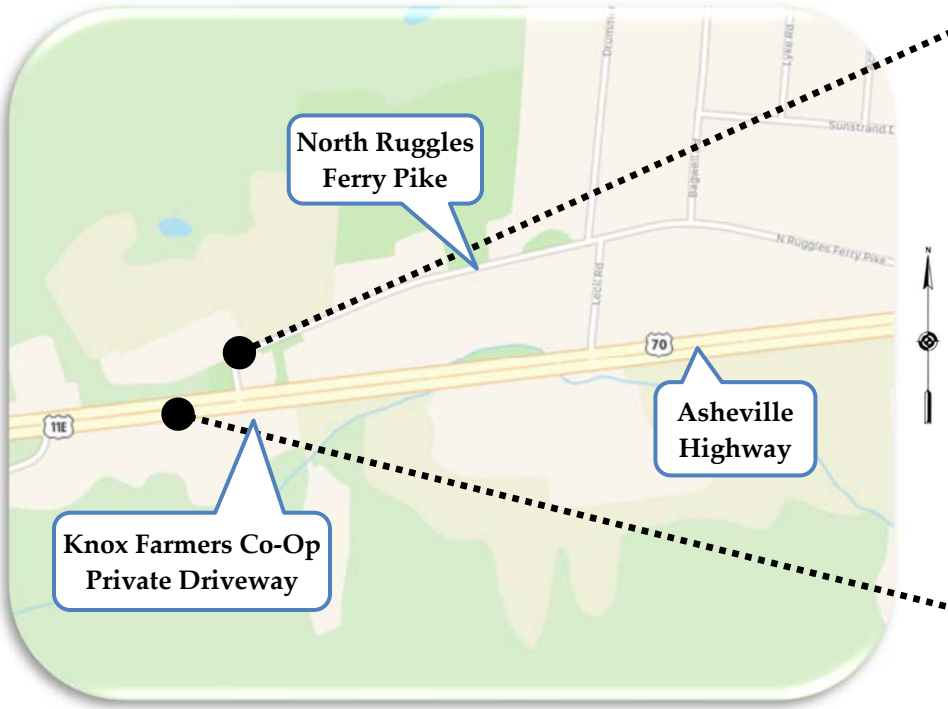
NORTH

FIGURE 2b

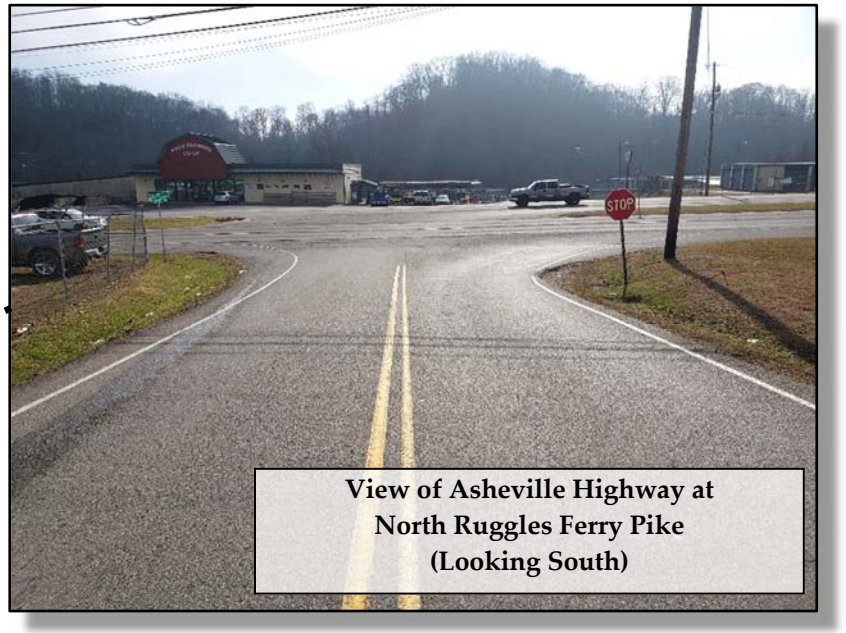
Innsbruck Farms

Traffic Count Locations, Traffic Signage & Existing Lane Configurations

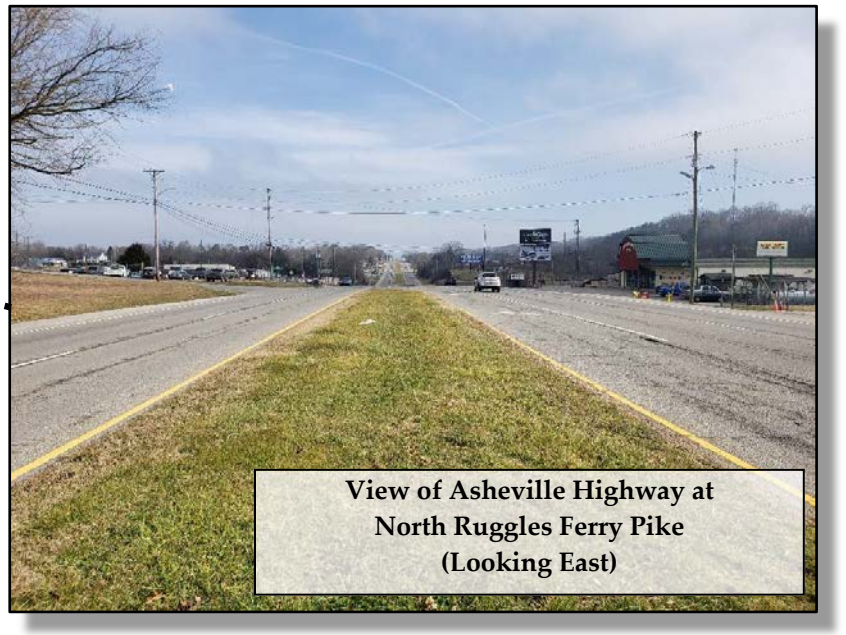
PHOTO EXHIBITS



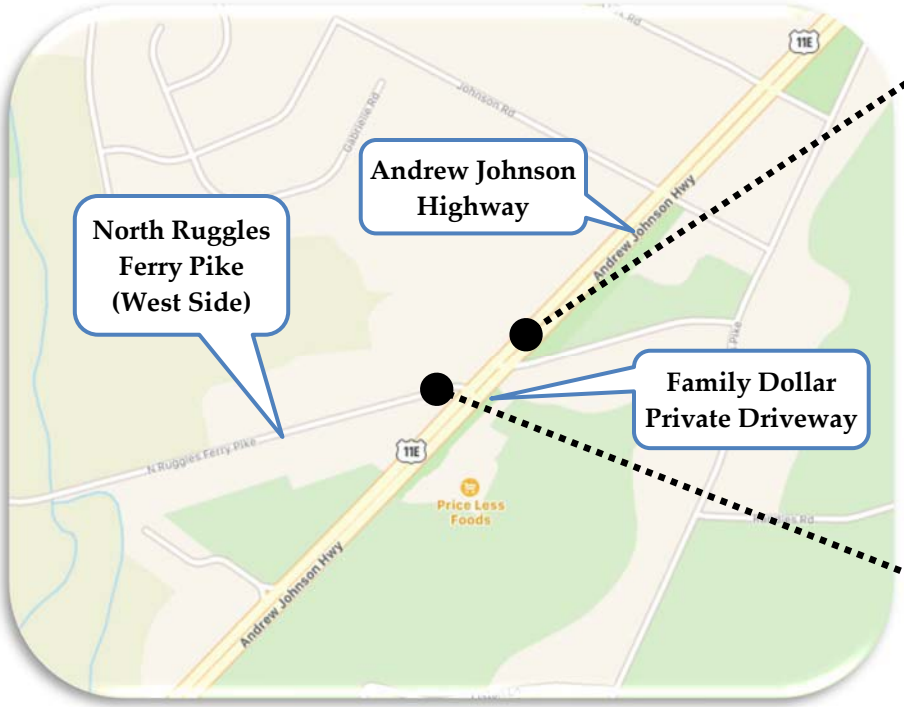
Asheville Highway at North Ruggles Ferry Pike



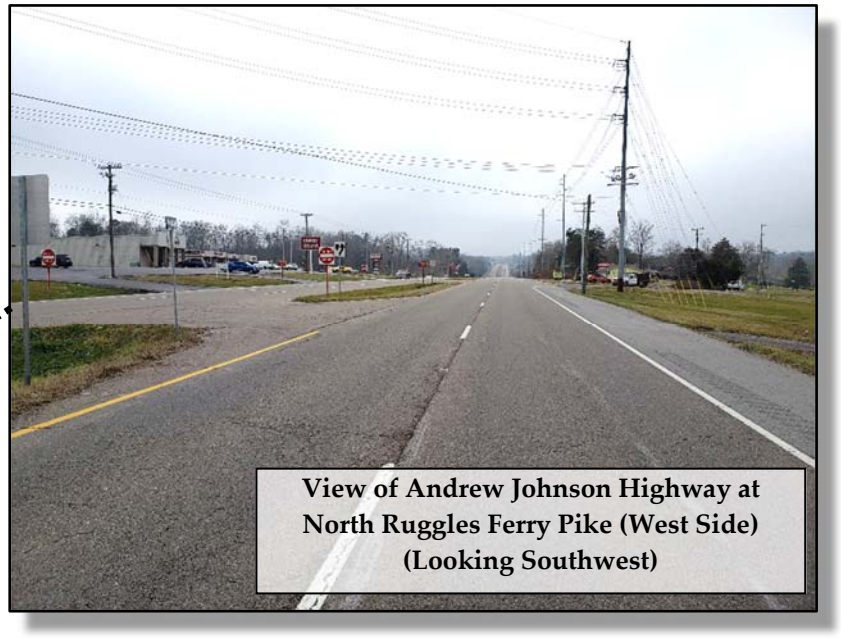
View of Asheville Highway at North Ruggles Ferry Pike (Looking South)



View of Asheville Highway at North Ruggles Ferry Pike (Looking East)

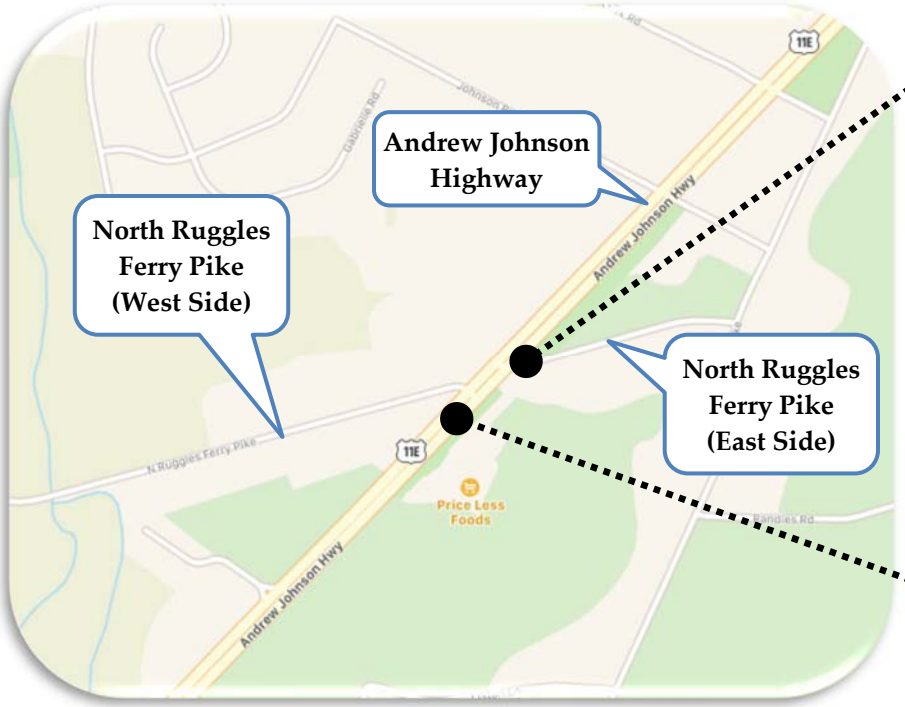


Andrew Johnson Highway at North Ruggles Ferry Pike



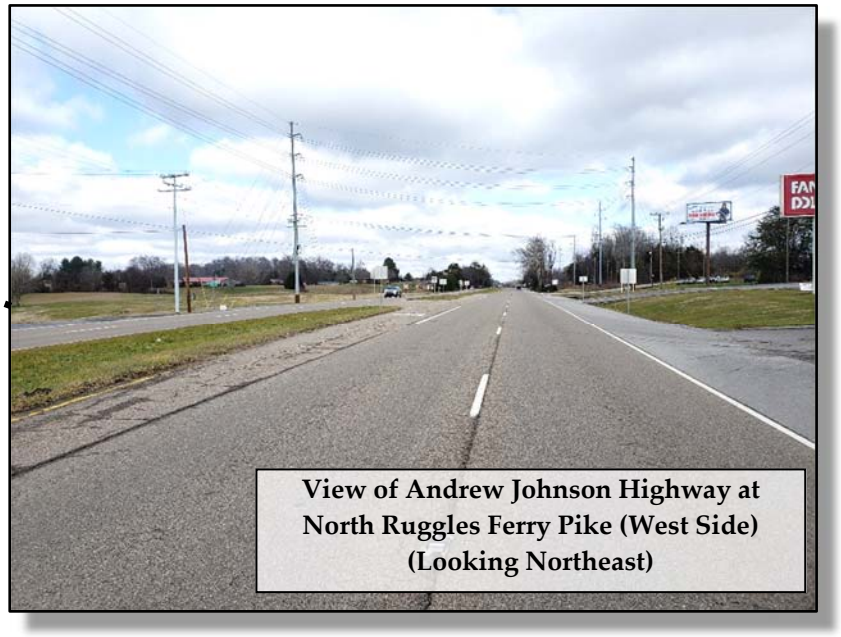
View of Andrew Johnson Highway at North Ruggles Ferry Pike (West Side) (Looking Southwest)

View of North Ruggles Ferry Pike (West Side) at Andrew Johnson Highway (Looking Northeast)

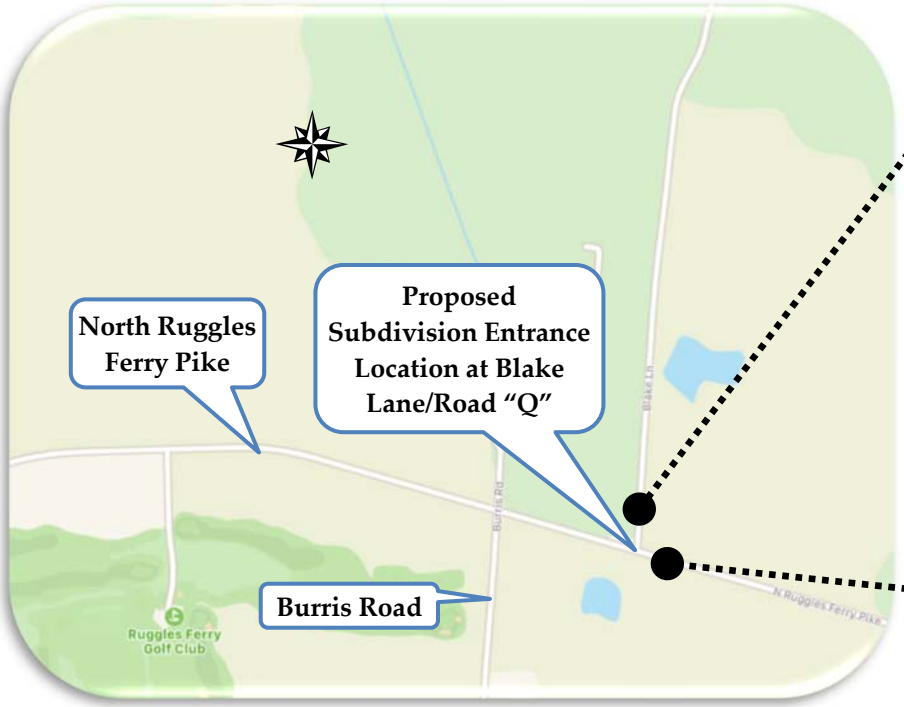


Andrew Johnson Highway at North Ruggles Ferry Pike

View of North Ruggles Ferry Pike (East Side) at Andrew Johnson Highway (Looking Southwest)



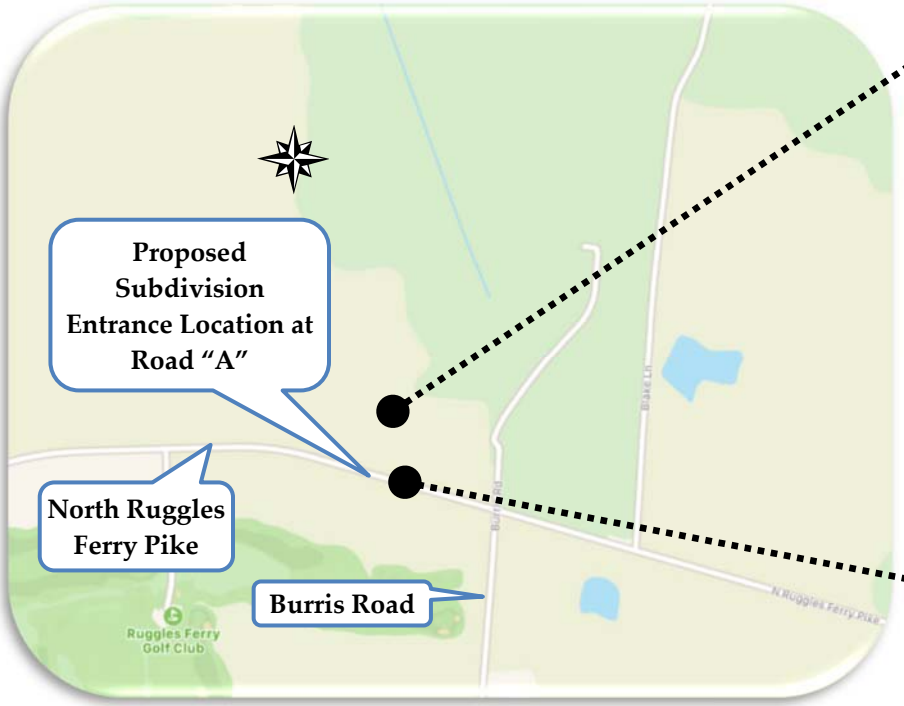
View of Andrew Johnson Highway at North Ruggles Ferry Pike (West Side) (Looking Northeast)



North Ruggles Ferry Pike at Blake Lane/Road "Q"
Proposed Subdivision Entrance Location

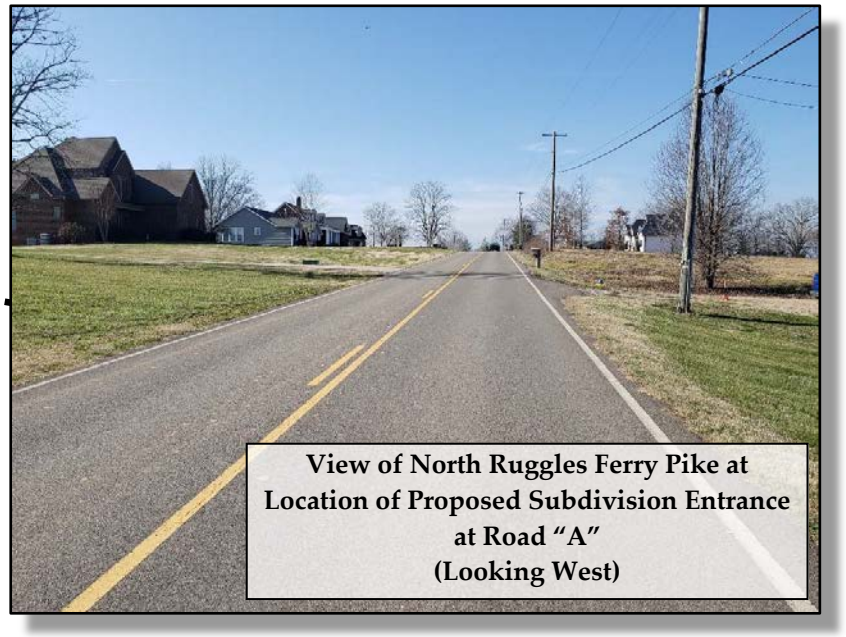
View of Proposed Subdivision Entrance Location of Blake Lane/Road "Q" at North Ruggles Ferry Pike (Looking South)

View of North Ruggles Ferry Pike at Proposed Subdivision Entrance Location Blake Lane/Road "Q" (Looking West)



North Ruggles Ferry Pike at Road "A"
Proposed Subdivision Entrance Location

View of Site at Location of Proposed Subdivision Entrance at Road "A" (Looking North)



View of North Ruggles Ferry Pike at Location of Proposed Subdivision Entrance at Road "A" (Looking West)

- **EXISTING TRANSPORTATION VOLUMES PER MODE:**

There are four permanent vehicular traffic count locations near the development site. Three of the count locations are conducted by the Tennessee Department of Transportation (TDOT) every year, and one is conducted every other year by the Knoxville Regional Transportation Planning Organization (TPO). The count location data is the following:

- Existing vehicular roadway traffic:
  - TDOT reported an Average Annual Daily Traffic (AADT) on Asheville Highway to the west of Meadow Trace Way and nearly due south of the project site at 23,115 vehicles per day in 2018. From 2008 – 2018, this count station has indicated a 0.1% average annual growth rate.
  - TDOT reported an Average Annual Daily Traffic (AADT) on Andrew Johnson Highway at Pleasant Hill Road and southeast of the project site at 19,610 vehicles per day in 2018. From 2008 – 2018, this count station has indicated a -0.3% average annual growth rate.
  - TDOT reported an Average Annual Daily Traffic (AADT) on North Ruggles Ferry Pike to the east of the project site at 628 vehicles per day in 2018. From 2008 – 2018, this count station has indicated a 1.2% average annual growth rate.
  - Knoxville TPO reported an Average Daily Traffic (ADT) on the western end of North Ruggles Ferry Pike just to the north of Asheville Highway at 2,480 vehicles per day in 2019. The counts at this location are conducted every odd year. Based on the limited data at this location, the average annual growth rate was calculated to be 1.8%.

  All the researched historical traffic count data for this report can be viewed in Appendix A.

- Existing bicycle and pedestrian volumes:

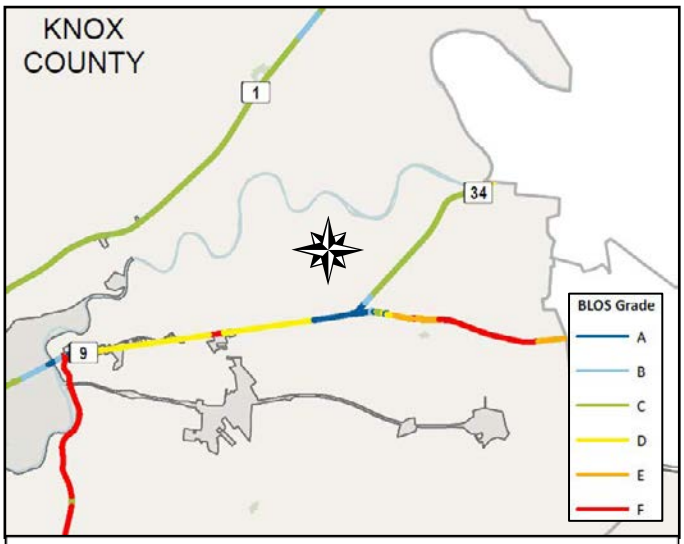
  The average daily pedestrian and bicycle traffic along and around the study corridor is not known. Only a couple of pedestrians were observed at the intersections during the manual traffic counts. No bicyclists were observed during the manual traffic counts.

- **ON-STREET PARKING:**

Currently, on-street parking is not allowed on any of the studied roadways adjacent to the project site. Off-street parking is permitted adjacent to the south approach of Asheville Highway at North Ruggles Ferry Pike. This parking is provided for the Knox Farmer Cooperative immediately to the south of the intersection. Off-street parking is also provided for the Family Dollar store just to the east of the intersection of Andrew Johnson Highway at North Ruggles Ferry Pike (West Side).

- **PEDESTRIAN AND BICYCLE FACILITIES:**

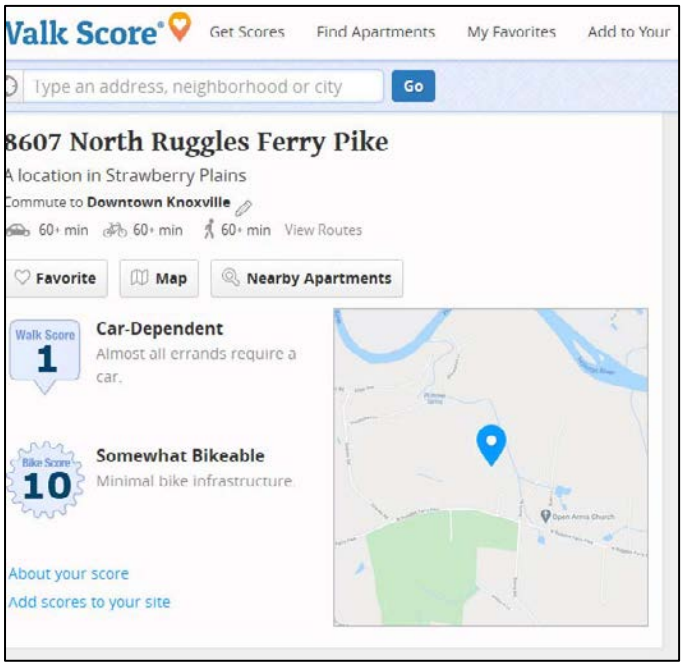
Bicycle facilities (lanes) are not currently available within the project site study area or any studied roadways. Sidewalks are not provided either. Even though bicycle facilities are not provided on Andrew Johnson Highway or Asheville Highway, TDOT has published mapping illustrating the Bicycle Level of Service (BLOS) for state routes in Knox County. BLOS is a nationally used measure of bicyclist comfort based on a roadway's geometry and traffic conditions. BLOS A designates the route as most suitable for bicyclists and BLOS F as the least suitable. The BLOS for Asheville Highway in the study area is shown with A, D, and F grades. Andrew Johnson Highway is given A, B, and C grades.



Mapping of Bicycle Level of Service (BLOS) - TDOT

Andrew Johnson Highway, just to the north of North Ruggles Ferry Pike, is marked as a Bike Route with signage. TDOT designates both Asheville Highway and Andrew Johnson Highway as Bike Routes, and both are proposed to be a part of an established statewide system of state highway bicycle routes. The statewide route proposed for Asheville Highway and Andrew Johnson Highway in the study area will run between Chattanooga, TN, and Mountain City, TN.

- **WALK SCORE:**



A private company offers an online website at walkscore.com that grades and gives scores to locations within the United States based on "walkability", "bikeability", and transit availability. According to the website, the numerical values assigned for the Walk Score and the Bike Score are based on the distance to the closest amenity in various relevant categories (businesses, schools, parks, etc.) and are graded from 0 to 100. The Transit Score measures how well a location is served by public transit based on distance and type of nearby transit. The Transit Score is also graded from 0 to 100.

Appendix B shows maps and other information for the Walk Score, Bike Score, and Transit Score at the approximate property site address (8607 North Ruggles Ferry Pike). The project location is graded with a Walk Score of 1. This Walk Score indicates that the site is entirely dependent on vehicles for errands and travel. The site is graded with a Bike Score of 10, which means there is minimal bike infrastructure but is somewhat bikeable. The site is not given a transit score.

- **TRANSIT SERVICES:**

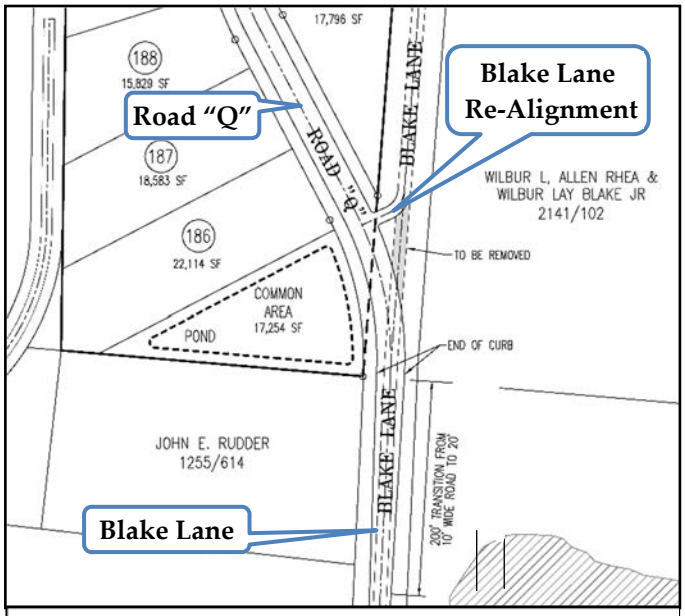
The City of Knoxville has a network of public transit opportunities offered by Knoxville Area Transit (KAT). Bus service is not available in this area of Knox County. The overall KAT bus system map is in Appendix C. The closest public transit bus service is 7 miles away to the southwest (by roadway) near the intersection of East Magnolia Avenue at South Chilhowee Drive. This KAT service is Route 31, "Magnolia Avenue". It operates on weekdays and weekends, and this route map is also included in Appendix C. Other transit services include the East Tennessee Human Resource Agency (ETHRA) and the Community Action Committee (CAC), which provides transportation services when requested. Private taxis and ride-sharing opportunities are also available in the study area.

PROJECT DESCRIPTION

- **LOCATION AND SITE PLAN:**

The proposed plan layout given by Norvell & Poe is shown in Figure 3. As shown in the figure, twenty-one new streets will be constructed for the subdivision. The total length of the new streets in the subdivision will be 27,526 feet (5.21 miles).

One of the subdivision entrances, Road "A", will intersect North Ruggles Ferry Pike at a t-intersection approximately 565 feet to the west of the existing intersection with Burris Road. Road "A" will be built with a boulevard typical road section with a 12-foot raised median flanked by 18-foot road lanes on each side for a length of 563 feet up to Road "B" inside the subdivision.

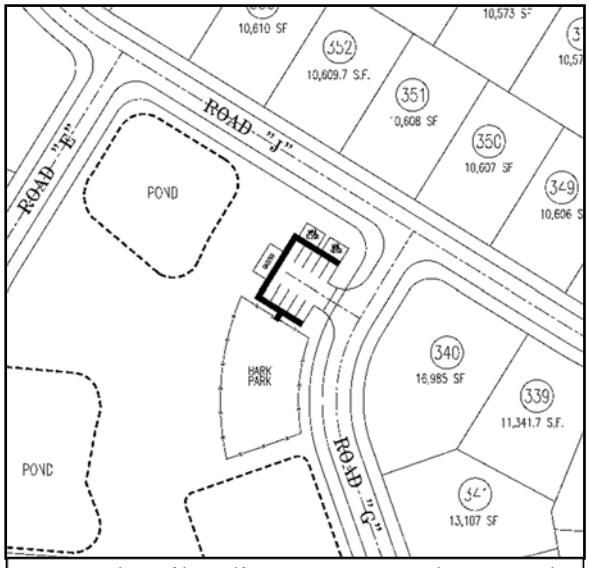


Blake Lane/Road "Q" Re-Alignment

The second subdivision entrance will be at the intersection of Blake Lane at North Ruggles Ferry Pike. Road "Q" in the subdivision will have a road width of 26 feet and will incorporate a portion of Blake Lane, which will be improved and widened. Blake Lane is currently only 13 feet wide. As part of this road improvement, a short 55' section of Blake Lane will be re-aligned to tie into Road "Q". A 200-foot section of roadway in between Road "Q" and Blake Lane will transition from 26 feet to 20 feet. To the south of the transition, Blake Lane will be widened to 20 feet past this transition section the entire length to North Ruggles Ferry Pike. This widening of Blake Lane will be just over 1,000 feet.

The 182.8-acre residential development will incorporate nine common areas, with many used to contain stormwater facilities. The layout and location of homes in the subdivision along the Holston River will abide by the 500-year flood limits. Adjacent to the intersection of Road "G" at Road "J", the development will have a centralized area with ten parking spaces for mail delivery and pickup for residents and a small area dedicated to a dog park. The development property is

currently composed of five separate parcels, and these will be consolidated accordingly. Two of these existing parcels currently have right-of-way access to North Ruggles Ferry Pike, one parcel currently has right-of-way access to Blake Lane to the east of the project site, and one parcel has access to Burris Road. However, no access is being proposed for the subdivision to Burris Road.



Internal Mail Delivery Center and Dog Park

As shown in Figure 3, Road "B" and Road "R" will terminate abruptly at the project property limits. These abrupt road terminations indicate that future residential development may occur on the adjacent vacant properties, but a determination has not been made at this time. This decision will be dependent on the willingness of the adjacent property owners, the future real estate market, and other market forces. Nevertheless, Road "B" and Road "R" will be constructed as if future development may occur sometime in the future.

The single-family residential detached lots will average between 10,000 -15,000 square feet (~0.25 acre - 0.33 acre) in size. Several of the lots along the Holston River will be over an acre in size, with the largest being 3.2 acres. Each home will have a garage and driveway.

The schedule for completion of this new residential development is dependent on economic factors and construction timelines. This project is also contingent on permitting, design, and other issues. However, for this study, it was assumed that the total construction build-out of the development and full occupancy would occur within the next seven years (2028).

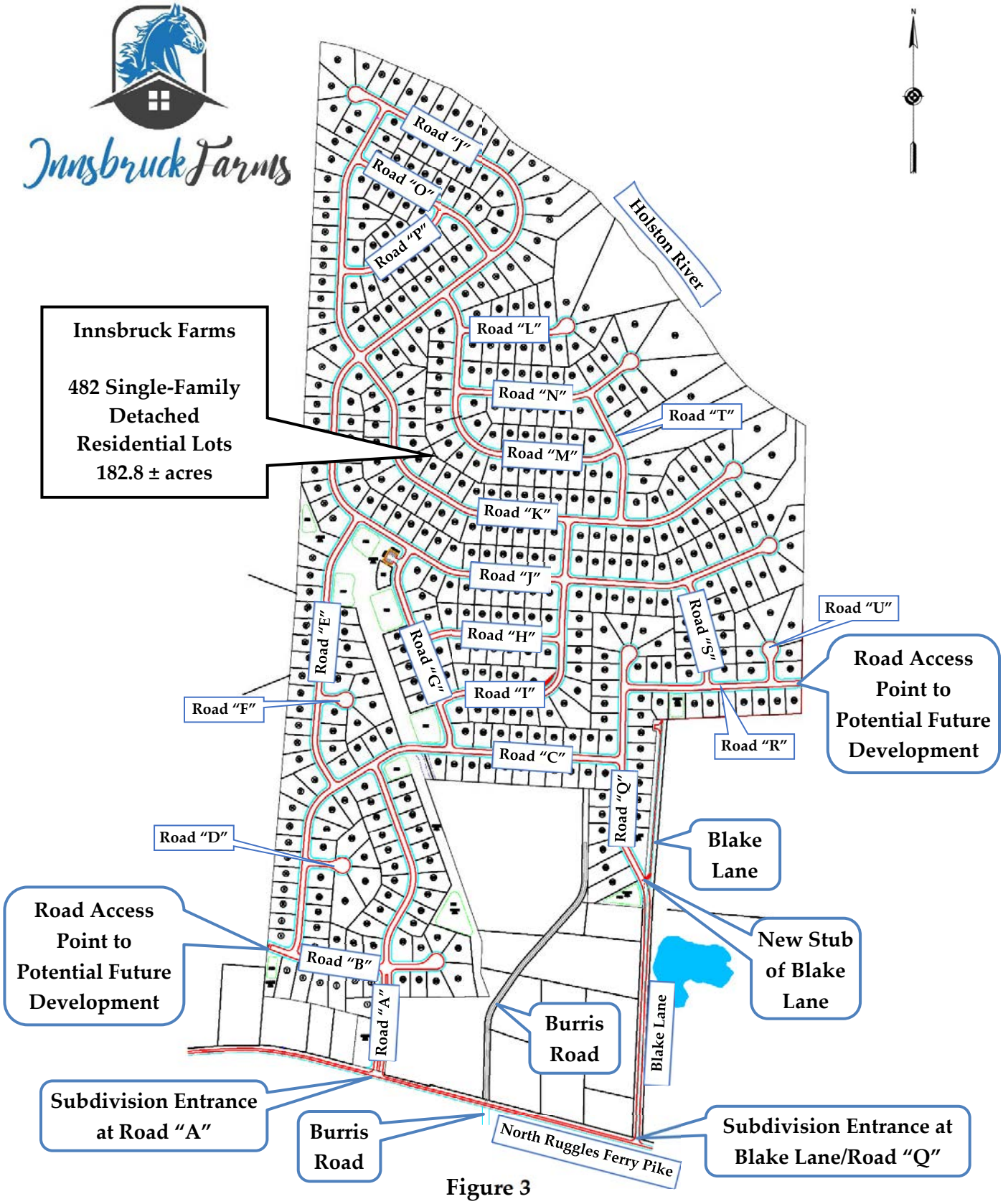


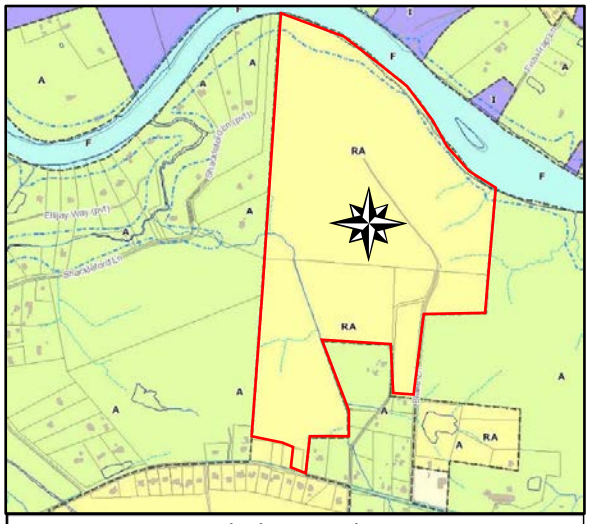
Figure 3
Proposed Plan Layout
Innsbruck Farms

Not to Scale

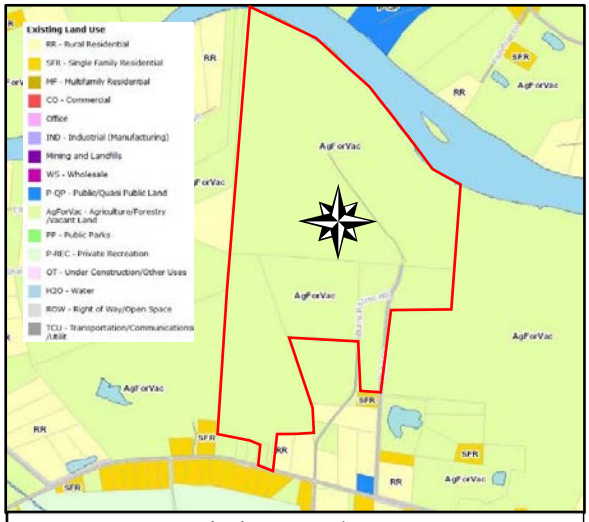
- **PROPOSED USES AND ZONING REQUIREMENTS:**

All five existing property parcels that comprise the proposed development are zoned as Low Density Residential (RA). The most recent published zoning map is provided in Appendix D. The Low Density Residential (RA) zone provides for low population densities for various land uses within the residential realm. Uses permitted in this zone include single-family dwellings, churches, public golf courses, and schools. The existing adjacent surrounding land uses are the following:

- The entire development property is surrounded by properties in the Agricultural (A) zone except for Holston River to the north and three small parcels to the southwest along North Ruggles Ferry Road. The three small parcels are zoned as Low Density Residential (RA), and the Holston River is listed under the Floodway (F) zone.
- All the surrounding properties' land uses are listed as vacant, agricultural, or consist of stand-alone single-family residences.



Existing Zoning



Existing Land Uses

- **DEVELOPMENT DENSITY:**

The Innsbruck Farms Subdivision's proposed density is based on a maximum of 482 houses on 182.8 acres. These amounts compute to 2.6 dwelling units per acre.

- **ON-SITE CIRCULATION:**

The total length of the twenty-one new streets within the development will be 27,526 feet (5.21 miles) and will be designed and constructed to Knox County, TN specifications. The new streets shown in Figure 3 are labeled Road "A" thru Road "U". The development will have asphalt paved internal roadways and include 8" extruded concrete curbs. The lane widths internally will be 13 feet each for a total 26-foot pavement width except for the beginning of Road "A". Road "A" will be a boulevard section and have 18-foot lanes with a raised 12-foot median. The street right-of-way within the development will be 50 feet. Concrete sidewalks are not being proposed along the internal roads. Knox County will maintain the streets in the subdivision after construction, and these will be dedicated public roads.

- **SERVICE AND DELIVERY VEHICLE ACCESS AND CIRCULATION:**

Besides residential passenger vehicles, the new streets will also provide access for service, delivery, maintenance, and fire protection/rescue vehicles. None of these other types of vehicles will impact roadway operations other than when they occasionally enter and exit the development. It is expected that curbside garbage collection services will be available for this residential subdivision. The new roads will be designed and constructed to Knox County specifications and expected to be adequate for fire protection and rescue vehicles. The subdivision's internal roadways are anticipated to accommodate the larger vehicle types and standard passenger vehicles.

TRAFFIC ANALYSIS OF EXISTING AND PROJECTED CONDITIONS

EXISTING TRAFFIC CONDITIONS:

Over the past year, the Covid-19 pandemic has not only closed schools and eliminated school-related traffic, but overall general traffic has been affected due to stay-at-home orders, work layoffs, job furloughs, and general anxiety with travel outside the home. More recently, while overall travel has noticeably increased and returned closer to pre-pandemic levels in the area, there is still a reduction in overall travel. This reduction can be attributed to some school-age children and families choosing to learn virtually online and due to professions and jobs that have transitioned to at-home work for the time being. Knox County Planning recently compiled traffic count data over Fall 2020 and determined that overall traffic volumes are still reduced compared to Fall 2019. A few of the Fall 2020 traffic counts compiled by Knox County Planning showed slight increases, but most count locations in the County have shown decreases ranging from 5% up to 30%.

For this study, traffic counts were conducted at the following existing unsignalized intersections as requested by Knox County Engineering:

- Asheville Highway at North Ruggles Ferry Pike
- Andrew Johnson Highway at North Ruggles Ferry Pike (West Side)
- Andrew Johnson Highway at North Ruggles Ferry Pike (East Side)
- North Ruggles Ferry Pike at Burris Road

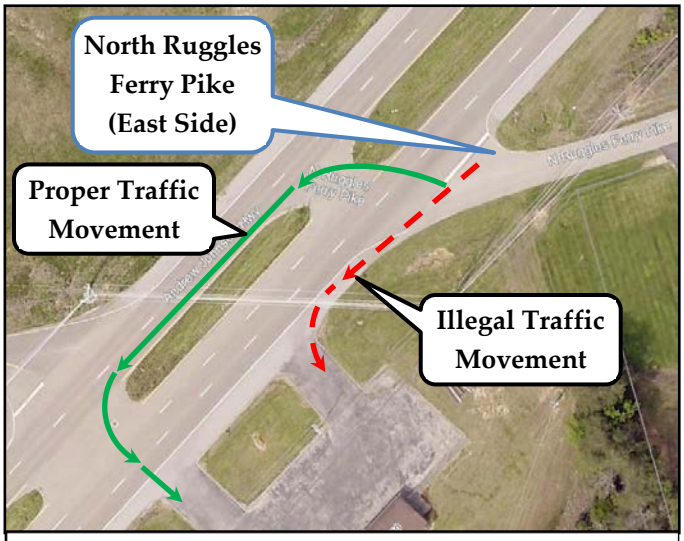
Manual traffic counts were obtained on Wednesday, January 13, 2021, for a total of eight hours at each studied intersection. The counts were conducted to tabulate the morning and afternoon peak periods. Local county public schools were in session when the traffic counts were conducted and had been open for a week since returning from the Christmas break. Providing a week buffer before counting allowed for school-related traffic to normalize to more established and solidified patterns. Based on the traffic volumes counted, the AM and PM peak hour of traffic were observed at the following times:

- Asheville Highway at North Ruggles Ferry Pike
  7:00 – 8:00 AM / 4:45 – 5:45 PM

- Andrew Johnson Highway at North Ruggles Ferry Pike (West Side)
  7:15 – 8:15 AM / 4:45 – 5:45 PM
- Andrew Johnson Highway at North Ruggles Ferry Pike (East Side)
  7:15 – 8:15 AM / 4:45 – 5:45 PM
- North Ruggles Ferry Pike at Burris Road
  7:15 – 8:15 AM / 4:15 – 5:15 PM

The manual tabulated traffic counts can be reviewed in Appendix E, and some observations are listed below.

It should be noted that even though westbound left-turn movements are prohibited at the intersection of Asheville Highway at North Ruggles Ferry Pike, several motorists were observed turning left into the Knox Farmers Cooperative parking lot during the manual traffic count.

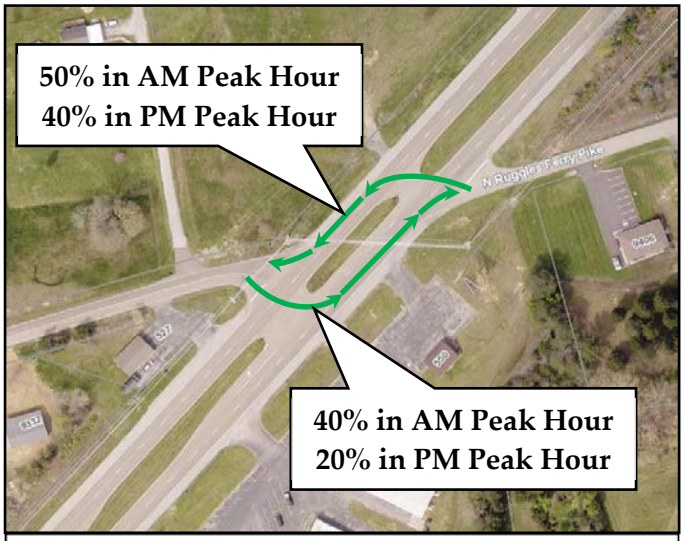


Illegal Maneuver Observed at Andrew Johnson Highway at North Ruggles Ferry Pike (East Side)

During the manual traffic counts, other vehicle maneuvers included motorists on North Ruggles Ferry Pike (East Side) illegally entering the Family Dollar shopping center. These illegal maneuvers involved entering Andrew Johnson Highway in the wrong direction of travel and entering the shopping center's first private driveway (northernmost). This illegal maneuver is done to avoid entering, crossing, and traveling southbound on Andrew Johnson Highway to the private driveway across North Ruggles Ferry Pike (West Side). Five of these illegal traffic movements were observed during the 8-hour traffic count.

For this study, the West Side and East Side skewed intersections of North Ruggles Ferry Pike at Andrew Johnson Highway are treated as two distinct intersections since they are separated by approximately 250 feet. The eastbound and westbound left-turning movements and the northbound and southbound right-turning movements at each of these intersections were tabulated as separate movements, but many of these movements on North Ruggles Ferry Pike

could be designated as "thru" travel across Andrew Johnson Highway. This "thru" travel was mainly observed in the morning for vehicles traveling from the West Side of North Ruggles Ferry Pike to the East Side of North Ruggles Ferry Pike. The opposite direction "thru" travel was observed from East to West, but it was considerably less pronounced. Specifically, the observations indicated that 40% of eastbound left turns from the North Ruggles Ferry Pike (West Side) in the AM Peak Hour were immediately followed by subsequent northbound right turns onto North Ruggles Ferry Pike (East Side). These same movements were observed during the PM Peak Hour at 20%. The opposite "thru" travel was observed at 50% in the AM Peak Hour and 30% in the PM Peak Hour.



"Thru" Movements Observed at Andrew Johnson Highway at North Ruggles Ferry Pike

It is speculated that these "thru" movements in the morning are related to Carter Middle and High School traffic from residents along and off North Ruggles Ferry Pike to the west of Andrew Johnson Highway. These schools are located just one mile to the south of North Ruggles Ferry Pike (East Side) at Strawberry Plains Pike intersection. Strawberry Plains Pike provides convenient access to the schools to the south of North Ruggles Ferry Pike (East Side).

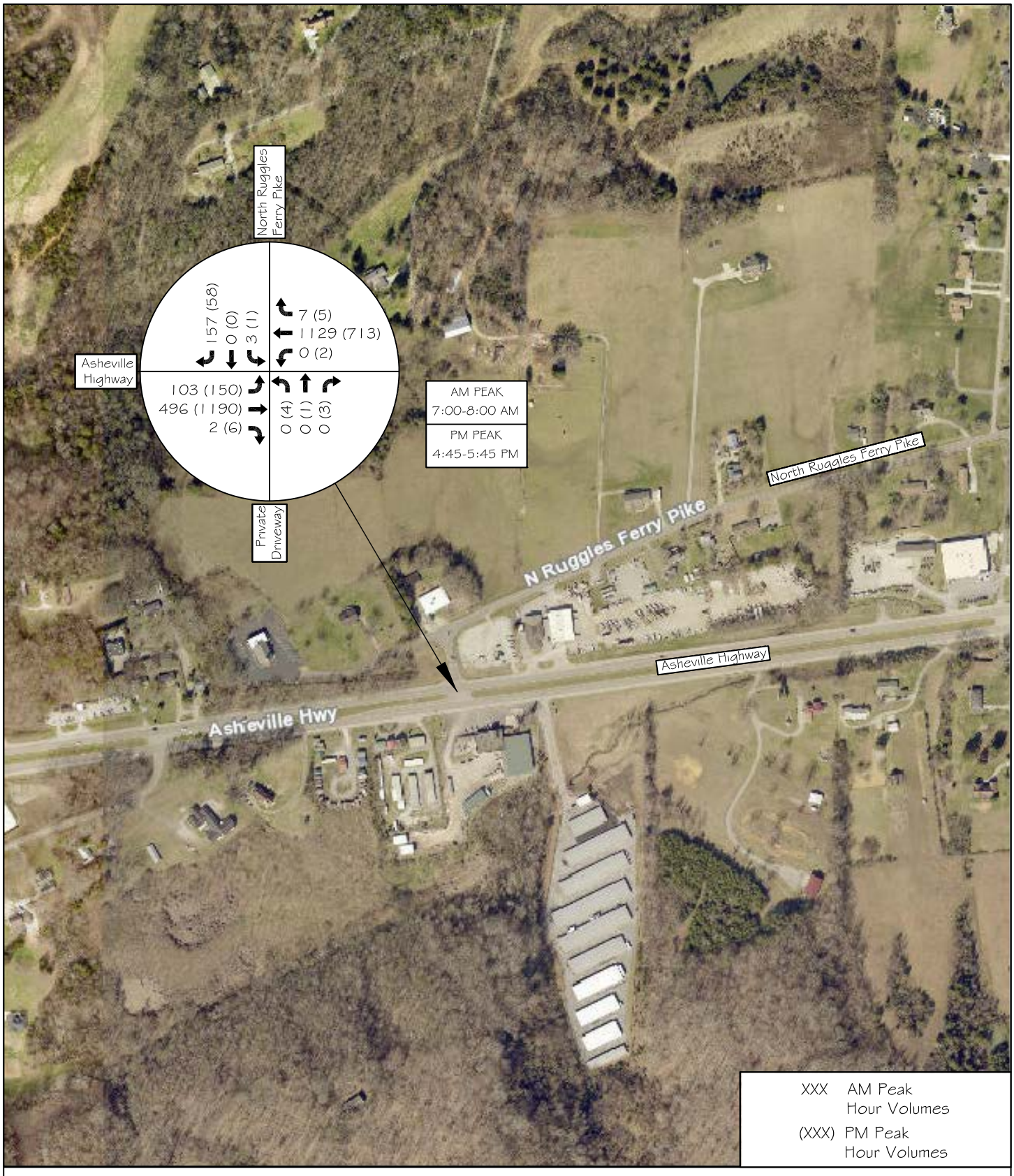
Many Knox County school buses were observed during the traffic counts. However, most of the traffic observed during the traffic counts were typical passenger vehicles with some large trucks and heavy vehicles. Large trucks and heavy vehicles were mostly observed in the thru movements on Asheville Highway and Andrew Johnson Highway. No bicyclists were observed during the traffic counts at any of the intersections. One pedestrian was observed walking eastbound on the south side of Asheville Highway at North Ruggles Ferry Pike. Three pedestrians were observed walking along North Ruggles Ferry Pike at Burris Road.

As discussed earlier, Knox County Planning has determined that traffic volumes in the area are still reduced due to the ongoing pandemic. At the direction of Knox County Planning, to account for potentially reduced traffic volumes due to the pandemic, this study has increased the tabulated traffic volumes at the intersections by a factor of 20%. This percentage is an average

value based on the local area sampling of traffic volumes comparing Fall 2019 traffic volumes with the recently obtained Fall 2020 traffic volumes.

Figures 4a and 4b show the volumes from the existing traffic counts during the AM and PM peak hours observed at the studied intersections. Figures 4c and 4d show the volumes from the existing traffic counts during the AM and PM peak hours observed at the studied intersections increased with the 20% factor.

A final note on the existing traffic volumes: the volumes shown at the intersection of Andrew Johnson Highway at North Ruggles Ferry Pike (East Side) includes a small amount of right-turn exiting traffic from the first private driveway (northernmost) at the Family Dollar store. These are not included in the volumes at Andrew Johnson Highway at North Ruggles Ferry Pike (West Side).



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

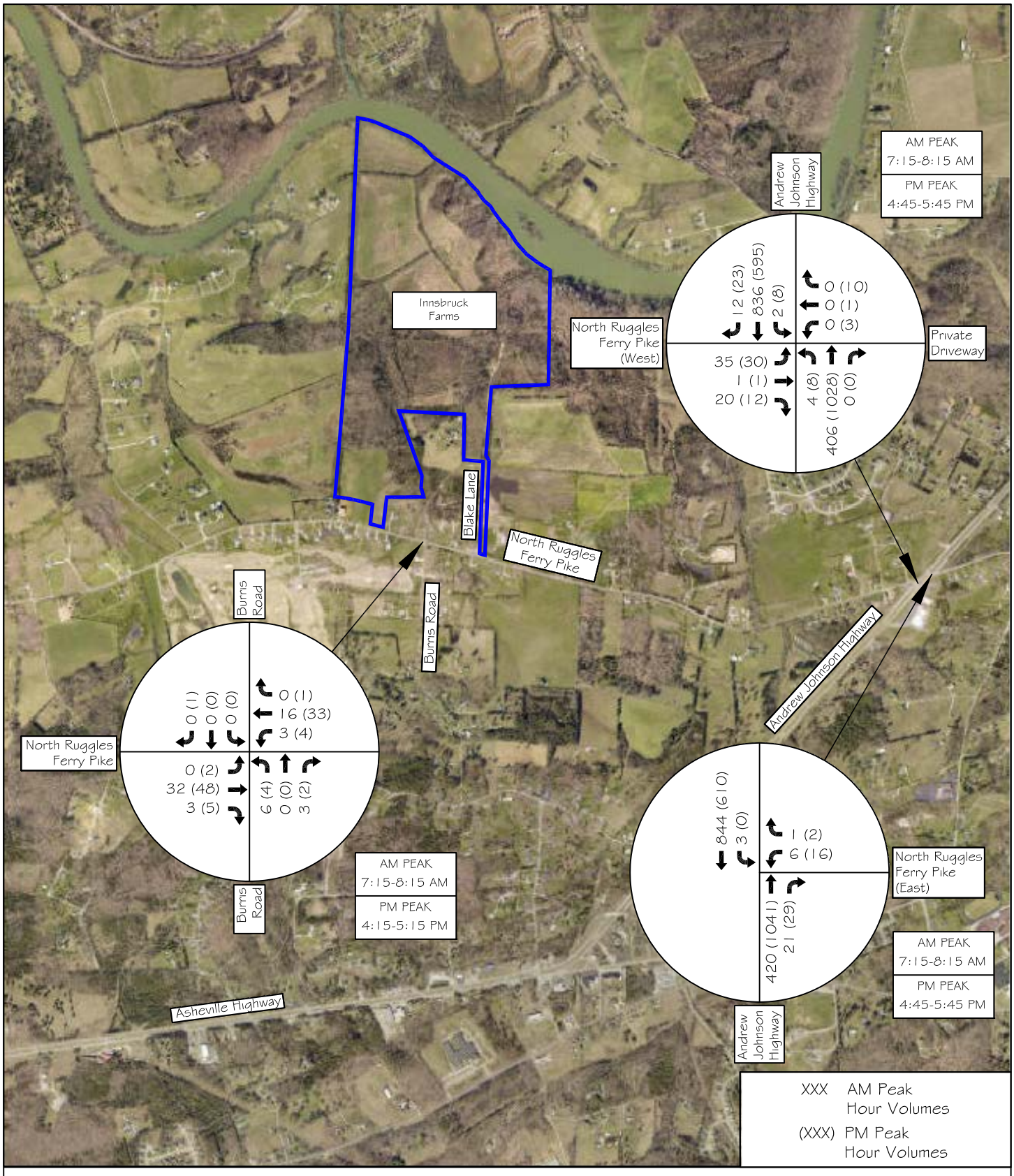
NOT TO SCALE

NORTH

FIGURE 4a

Innsbruck Farms

2021 Peak Hour Traffic Volumes - EXISTING TRAFFIC CONDITIONS



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

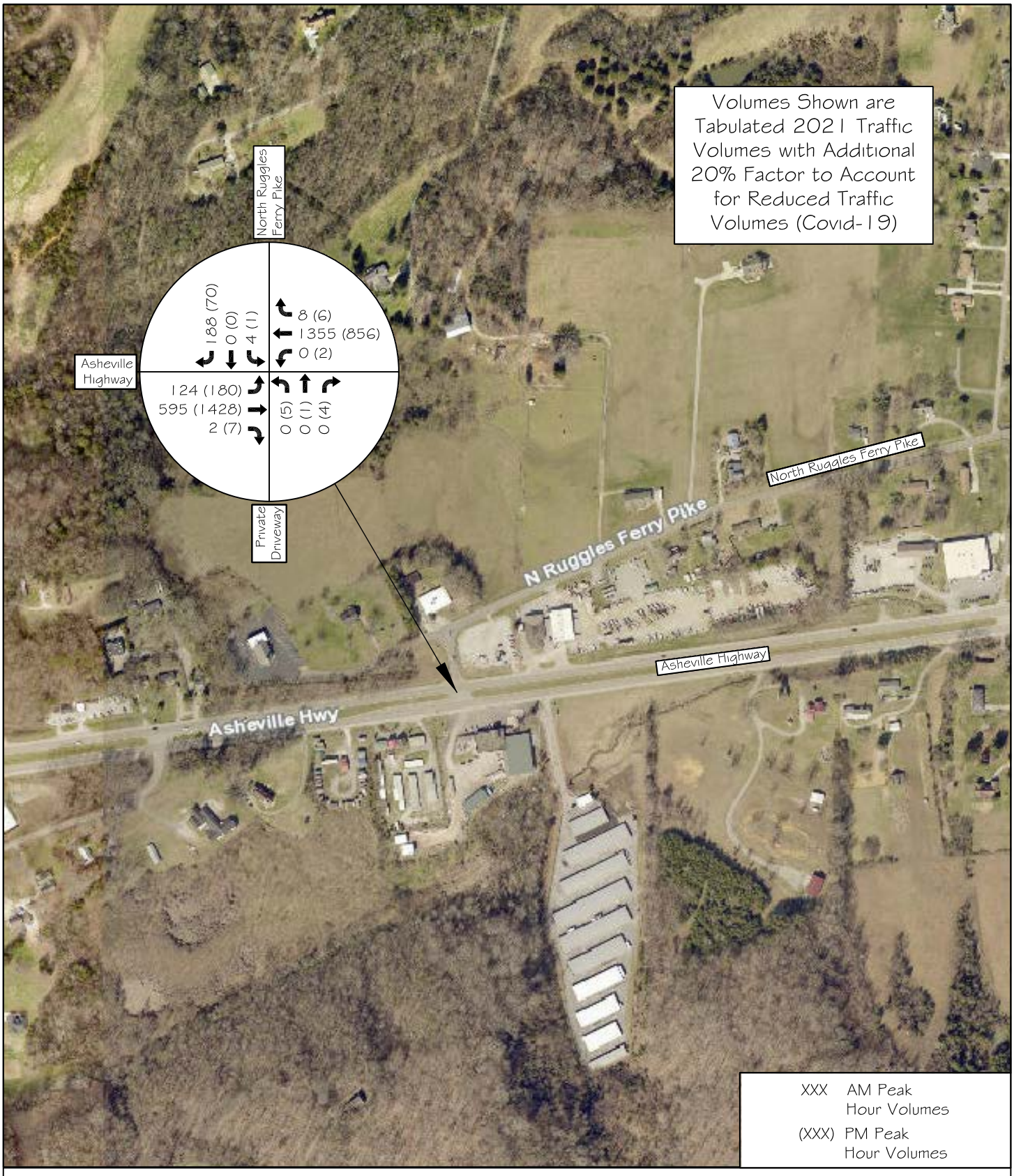
NOT TO SCALE

NORTH

FIGURE 4b

Innsbruck Farms

2021 Peak Hour Traffic Volumes - EXISTING TRAFFIC CONDITIONS



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

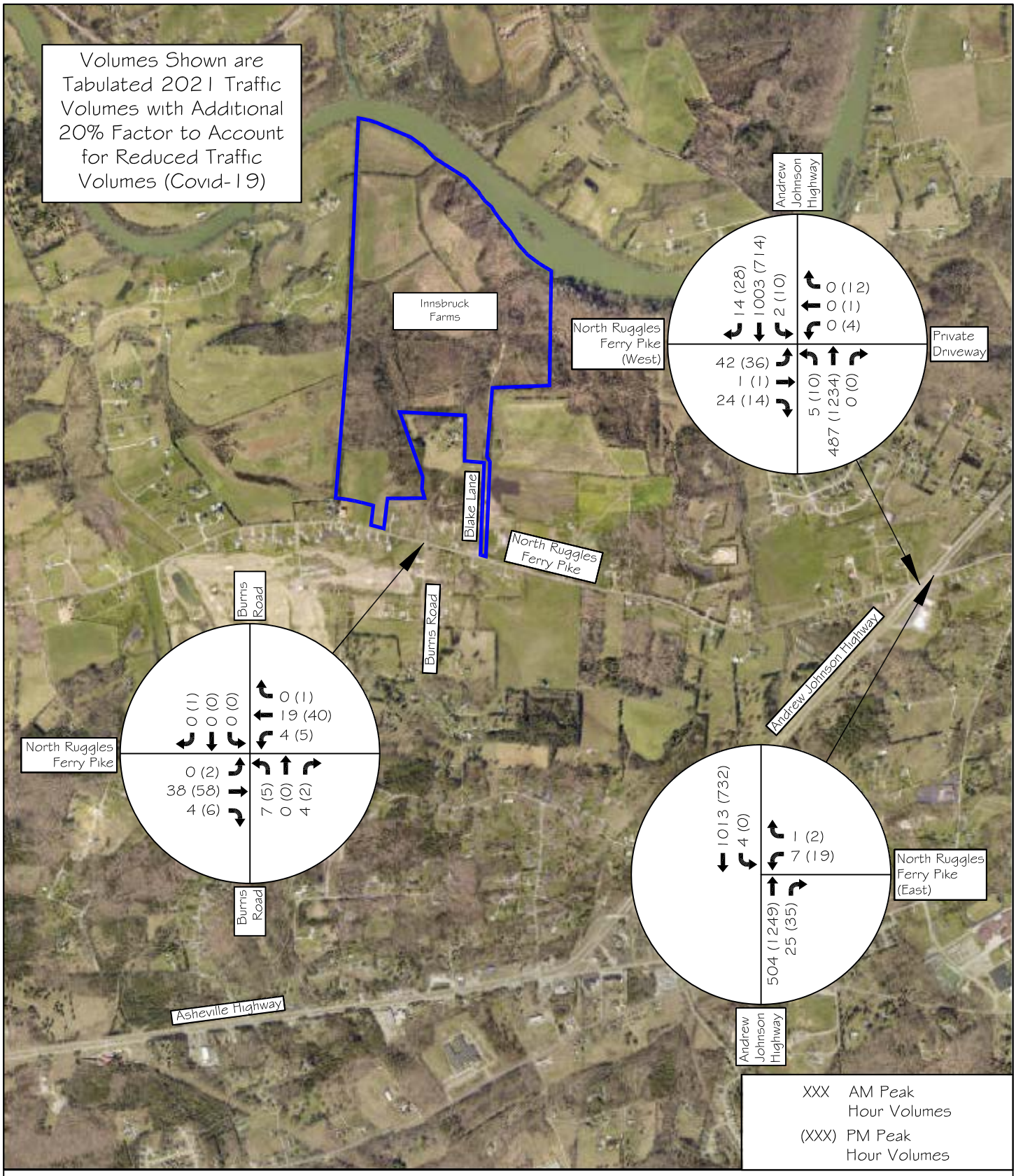
NOT TO SCALE

NORTH

FIGURE 4c

Innsbruck Farms

2021 Peak Hour Traffic Volumes with 20% Factor Increase - EXISTING TRAFFIC CONDITIONS



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

NOT TO SCALE

NORTH

FIGURE 4d

Innsbruck Farms

2021 Peak Hour Traffic Volumes with 20% Factor Increase - EXISTING TRAFFIC CONDITIONS

Capacity analyses were undertaken to determine the Level of Service (LOS) for the studied intersections for both the existing year 2021 traffic volumes shown in Figures 4a and 4b and Figures 4c and 4d with a 20% factor increase. The capacity analyses were calculated by following the Highway Capacity Manual (HCM) methods and Synchro Traffic Software (Version 8).

Methodology:

LOS is a qualitative measurement developed by the transportation profession to express how well an intersection or roadway performs based on a driver's perception. LOS designations include LOS A through LOS F. The designation of LOS A signifies a roadway or intersection operating at best, while LOS F signifies road operations at worst. This grading system provides a reliable, straightforward means to communicate road operations to the public. The HCM lists level of service criteria for unsignalized intersections and signalized intersections.

LOS is defined by delay per vehicle (seconds), and roadway facilities are also characterized by the volume-to-capacity ratio (v/c). For example, a delay of 20 seconds at an unsignalized intersection would indicate LOS C, and this delay would represent the additional delay a motorist would experience traveling through the intersection. Also, for example, a v/c ratio of 0.75 for an approach at an unsignalized intersection would indicate that it is operating at 75% of its available capacity. LOS designations, which are based on delay, are reported differently for unsignalized and signalized intersections. This difference is primarily due to motorists having different expectations between the two road facilities. Generally, for most instances, the LOS D / LOS E boundary is considered the upper limit of acceptable delay during peak periods in urban and suburban areas.

For unsignalized intersections, LOS is measured in terms of delay (in seconds). This measure is an attempt to quantify delay that includes travel time, driver discomfort, and fuel consumption. For unsignalized intersections, the analysis assumes that the mainline thru and right-turn traffic does not stop and is not affected by the traffic on the minor side

> streets. Thus, the LOS for a two-way stop (or yield) controlled intersection is defined by the delay for each minor approach and major street left-turn movements. Table 2 lists the level of service criteria for unsignalized intersections. The analysis results of unsignalized intersections using the HCM methodologies are conservative due to the more significant vehicle gap parameters used in the method. More often, in normal road conditions, drivers are more willing to accept smaller gaps in traffic than what is modeled using the HCM methodology. The unsignalized intersection methodology also does not account for more significant gaps sometimes produced by nearby upstream and downstream signalized intersections. For unsignalized intersections, in most instances, the upper limit of acceptable delay during peak hours is the LOS D/E boundary at 35 seconds.

Capacity calculations from the existing peak hour traffic at the intersections are shown in Tables 3a and 3b for the intersections. Table 3a shows the results based on the existing tabulated traffic counts. Table 3b shows the results based on the existing tabulated traffic counts with a 20% factor increase. The intersections in the tables are shown with a LOS designation, delay (in seconds), and v/c ratio (volume/capacity) for the AM and PM peak hours. Appendix F includes the worksheets from the capacity analyses for the existing peak hour vehicular traffic.

The minor North Ruggles Ferry Pike approaches at the intersections on Asheville Highway and Andrew Johnson Highway are calculated to operate very poorly during the existing AM and PM peak hours. When the traffic volumes are increased by 20%, the results indicate LOS F with considerable vehicle delays. The intersection of North Ruggles Ferry Pike at Burris Road has low traffic volumes, and all reportable traffic movements are calculated to be LOS A.

TABLE 2
LEVEL OF SERVICE AND DELAY FOR UNSIGNALIZED INTERSECTIONS

LEVEL OF SERVICE	DESCRIPTION	CONTROL DELAY (seconds/vehicle)
A	Little or no delay	0 - 10
B	Short Traffic Delays	>10 -15
C	Average Traffic Delays	>15 - 25
D	Long Traffic Delays	>25 - 35
E	Very Long Traffic Delays	>35 - 50
F	Extreme Traffic Delays	>50

Source: Highway Capacity Manual, 6th Edition

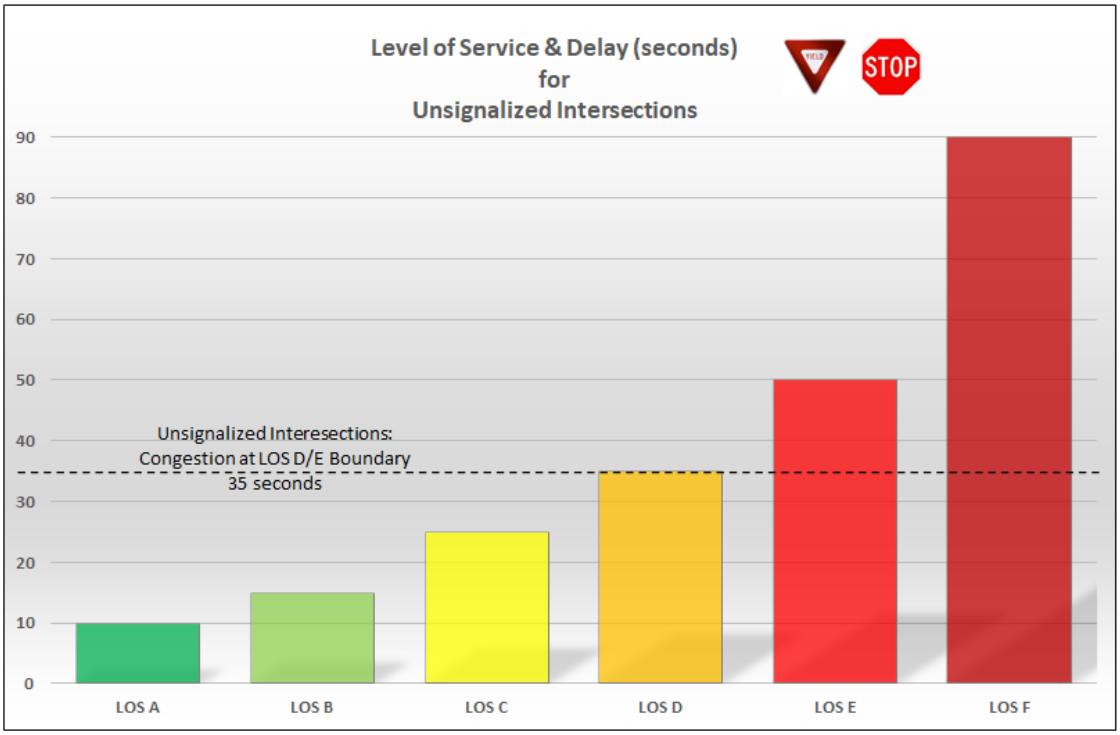


TABLE 3a
2021 UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS -
EXISTING TRAFFIC CONDITIONS

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Asheville Highway at North Ruggles Ferry Pike	Unsignalized	Eastbound Left	C	15.5	0.310	B	11.6	0.230
		Westbound Left	-	0.0	0.000	A	0.4	0.010
		Northbound Left/Thru/Right	A	0.0	0.000	E	47.0	0.120
		Southbound Left/Thru/Right	D	32.5	0.650	B	14.6	0.150
Andrew Johnson Highway at North Ruggles Ferry Pike (West Side)	Unsignalized	Eastbound Left/Thru/Right	E	46.5	0.470	E	49.3	0.410
		Westbound Left/Thru/Right	A	0.0	0.000	D	28.9	0.160
		Northbound Left	B	10.7	0.020	A	9.1	0.020
		Southbound Left	A	0.2	0.010	A	1.0	0.030
Andrew Johnson Highway at North Ruggles Ferry Pike (East Side)	Unsignalized	Westbound Left/Right	C	19.3	0.060	D	34.2	0.190
		Southbound Left	A	0.1	0.010	-	0.0	0.000
North Ruggles Ferry Pike at Burris Road	Unsignalized	Eastbound Left/Thru/Right	-	0.0	0.000	A	0.4	0.000
		Westbound Left/Thru/Right	A	0.8	0.000	A	1.5	0.010
		Northbound Left/Thru/Right	A	8.9	0.020	A	9.2	0.010
		Southbound Left/Thru/Right	A	0.0	0.000	A	8.5	0.000

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

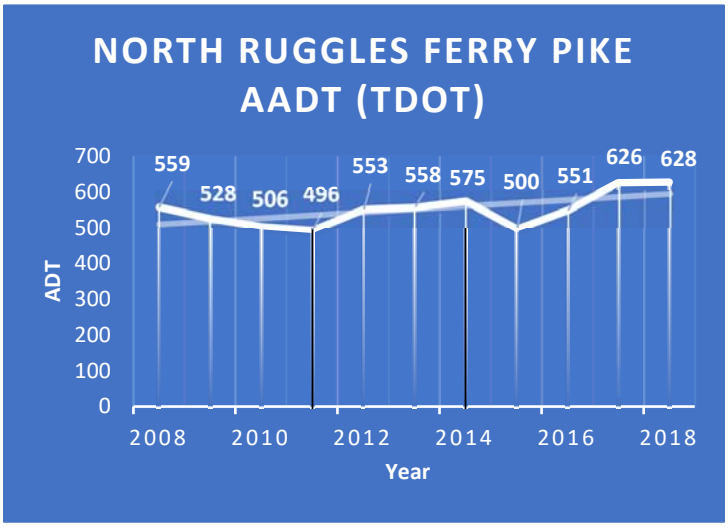
TABLE 3b
2021 UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS -
EXISTING TRAFFIC CONDITIONS (+20%)

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Asheville Highway at North Ruggles Ferry Pike	Unsignalized	Eastbound Left	C	22.4	0.480	B	13.8	0.330
		Westbound Left	-	0.0	0.000	A	0.5	0.020
		Northbound Left/Thru/Right	A	0.0	0.000	F	90.8	0.260
		Southbound Left/Thru/Right	F	96.8	1.010	C	17.3	0.220
Andrew Johnson Highway at North Ruggles Ferry Pike (West Side)	Unsignalized	Eastbound Left/Thru/Right	F	128.9	0.860	F	142.4	0.810
		Westbound Left/Thru/Right	A	0.0	0.000	F	51.0	0.300
		Northbound Left	B	12.0	0.030	A	9.7	0.030
		Southbound Left	A	0.2	0.010	A	1.4	0.050
Andrew Johnson Highway at North Ruggles Ferry Pike (East Side)	Unsignalized	Westbound Left/Right	D	25.6	0.090	F	60.9	0.330
		Southbound Left	A	0.2	0.010	-	0.0	0.000
North Ruggles Ferry Pike at Burris Road	Unsignalized	Eastbound Left/Thru/Right	-	0.0	0.000	A	0.3	0.000
		Westbound Left/Thru/Right	A	0.9	0.000	A	1.6	0.010
		Northbound Left/Thru/Right	A	9.0	0.020	A	9.4	0.020
		Southbound Left/Thru/Right	A	0.0	0.000	A	8.5	0.000

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

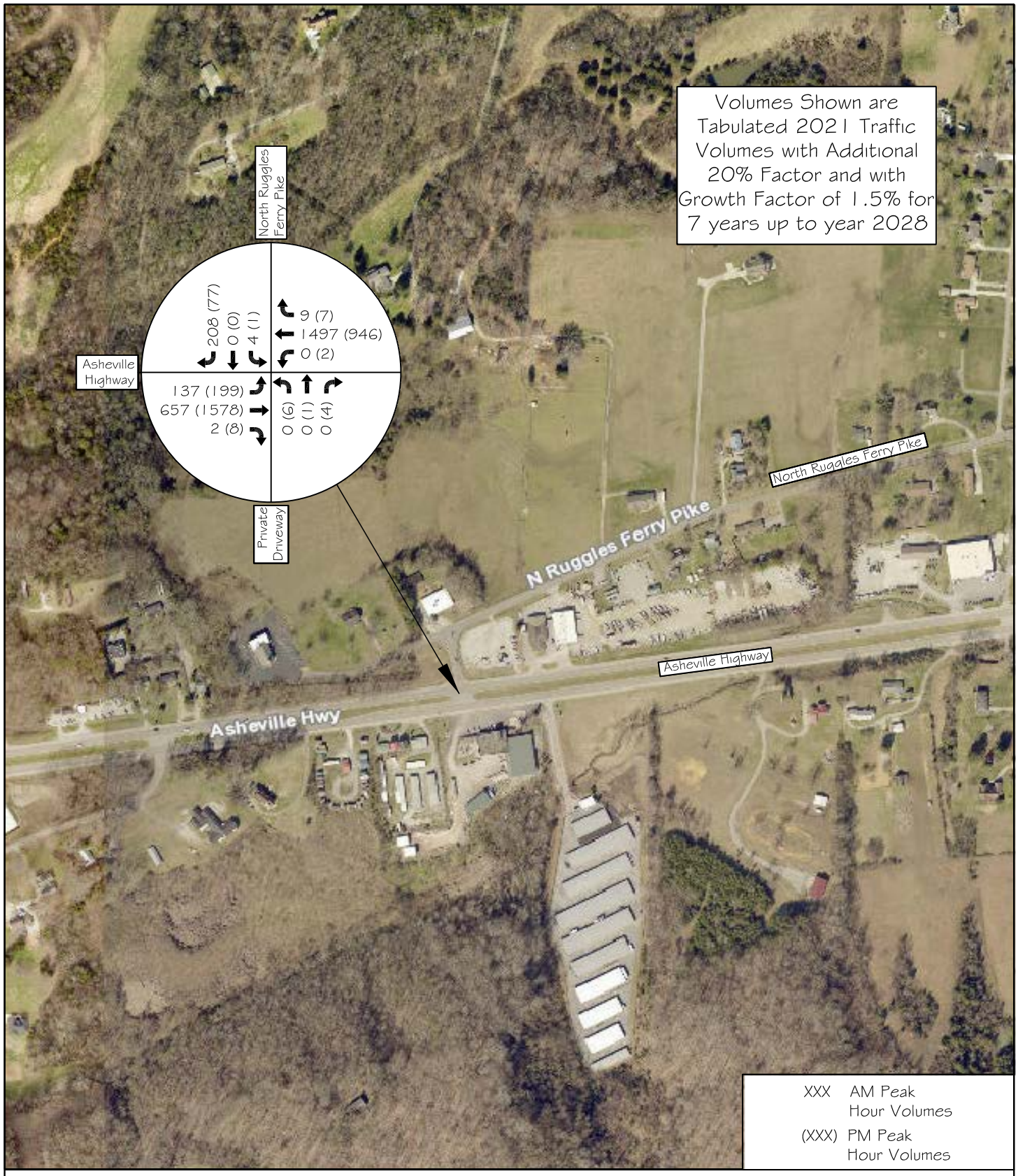
- **OPENING YEAR TRAFFIC CONDITIONS (WITHOUT THE PROJECT):**

Opening year traffic volumes represent the future condition the proposed study area is potentially subject to even without the proposed project being developed (no-build option). As previously stated, the build-out and full occupancy for this proposed development is assumed to occur in 2028. This horizon year corresponds to seven years for this extensive residential development to reach full capacity and occupancy.



Vehicular traffic on Asheville Highway, Andrew Johnson Highway, and North Ruggles Ferry Pike has shown flat to minimal growth over the past few years, according to the permanent traffic count stations and as shown in Appendix A. To conservatively account for potential traffic growth in the study area, an average annual growth rate of 1.5% was used to calculate future growth up to 2028 for the studied intersections. This growth rate is applied on top of the 20% factor applied to the tabulated existing traffic counts to account for reduced traffic levels from the current pandemic. The results of this growth rate applied to the existing 2021 traffic volumes from Figures 4c and 4d (with 20% factor) are shown in Figures 5a and 5b. Figures 5a and 5b show the projected opening year traffic volumes at the studied intersections in 2028 during the AM and PM peak hours without the project.

Capacity analyses were conducted for the future projected conditions at the studied intersections in the year 2028 without the project being developed. The results from the 2028 projected opening year traffic conditions (without the project) can be seen in Table 4 for the intersections. Appendix F contains the LOS capacity worksheets for the opening year conditions (without the project) in 2028. It is important to point out that these projected calculated LOS designations for the intersections could exist in the future, even without the proposed residential project being constructed and developed. The minor North Ruggles Ferry Pike approaches at the intersections of Asheville Highway and Andrew Johnson Highway are shown to operate even worse during the projected AM and PM peak hours without the project in the year 2028.



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

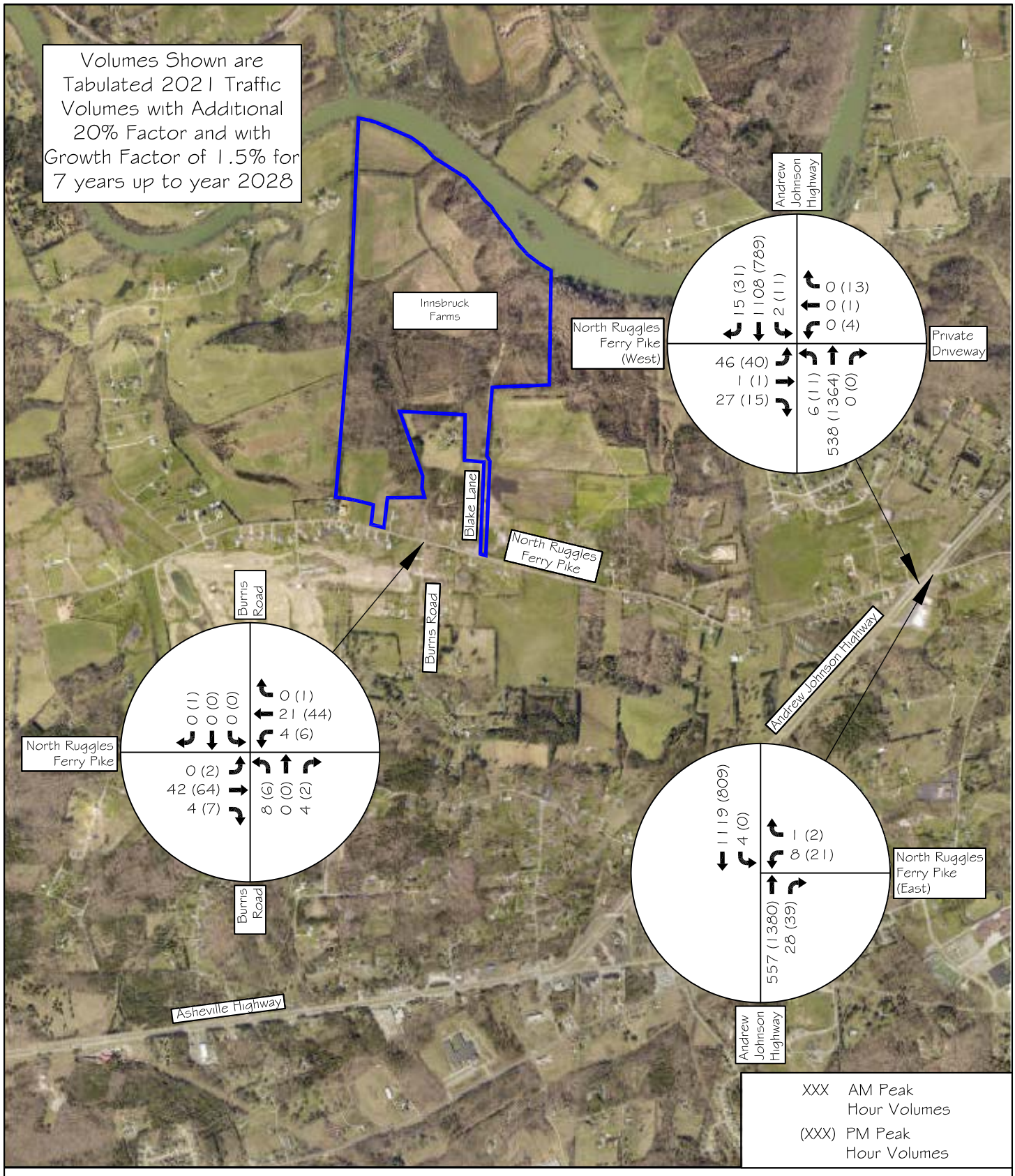
NOT TO SCALE

NORTH

FIGURE 5a

Innsbruck Farms

2028 Peak Hour Traffic Volumes - OPENING YEAR TRAFFIC (WITHOUT THE PROJECT)



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

NOT TO SCALE

NORTH

FIGURE 5b

Innsbruck Farms

2028 Peak Hour Traffic Volumes - OPENING YEAR TRAFFIC (WITHOUT THE PROJECT)

TABLE 4
2028 UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS - OPENING YEAR (2028 WITHOUT THE PROJECT)

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Asheville Highway at North Ruggles Ferry Pike	Unsignalized	Eastbound Left	D	31.7	0.620	C	16.0	0.400
		Westbound Left	-	0.0	0.000	A	0.7	0.020
		Northbound Left/Thru/Right	A	0.0	0.000	F	219.0	0.520
		Southbound Left/Thru/Right	F	200.2	1.290	C	19.9	0.270
Andrew Johnson Highway at North Ruggles Ferry Pike (West Side)	Unsignalized	Eastbound Left/Thru/Right	F	277.4	1.250	F	325.7	1.260
		Westbound Left/Thru/Right	A	0.0	0.000	F	77.6	0.430
		Northbound Left	B	13.0	0.040	B	10.1	0.040
		Southbound Left	A	0.2	0.010	A	1.8	0.060
Andrew Johnson Highway at North Ruggles Ferry Pike (East Side)	Unsignalized	Westbound Left/Right	D	31.5	0.130	F	96.9	0.490
		Southbound Left	A	0.2	0.010	-	0.0	0.000
North Ruggles Ferry Pike at Burris Road	Unsignalized	Eastbound Left/Thru/Right	-	0.0	0.000	A	0.3	0.000
		Westbound Left/Thru/Right	A	0.8	0.000	A	1.7	0.010
		Northbound Left/Thru/Right	A	9.1	0.020	A	9.6	0.020
		Southbound Left/Thru/Right	A	0.0	0.000	A	8.6	0.000

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections

[a] Level of Service

[b] Average Delay (sec/vehicle)

[c] Volume-to-Capacity Ratio

- **TRIP GENERATION:**

The estimated amount of traffic generated by the proposed residential development was calculated based upon rates and equations for peak hour trips provided by Trip Generation Manual, 10th Edition, a publication of the Institute of Transportation Engineers (ITE). A generated trip is a single or one-direction vehicle movement that is either entering or exiting the study site. The Trip Generation Manual is the traditional and most popular resource for determining trip generation rates when traffic impact studies are produced. The Manual lists and includes data for various land uses and correlates trips generated based on different variables such as dwelling units, square footage, etc. The data from ITE for the proposed land use is shown in Appendix G. A summary of this information is presented in the following table:

TABLE 5
TRIP GENERATION FOR INNSBRUCK FARMS SUBDIVISION
482 Single-Family Detached Houses

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
#210	Single-Family Detached Housing	482 Houses	4,420	25%	75%		63%	37%	
				87	261	348	290	170	460
Total New Volume Site Trips			**4,420**	**87**	**261**	**348**	**290**	**170**	**460**

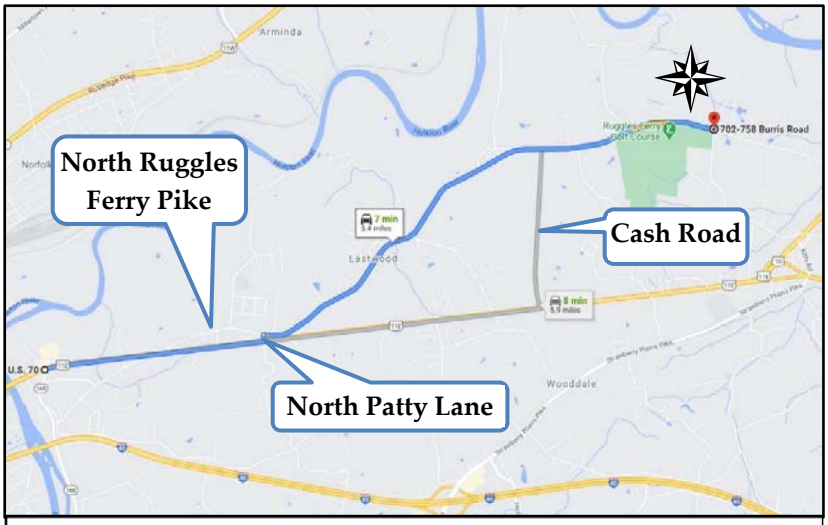
ITE Trip Generation Manual, 10th Edition
Trips calculated by using Fitted Curve Equation

For the proposed residential subdivision, with 482 single-family detached houses, it is estimated that 87 vehicles will enter and 261 will exit, for a total of 348 generated trips during the AM Peak Hour in the year 2028. Similarly, it is estimated that 290 vehicles will enter and 170 will exit, for a total of 460 generated trips during the PM Peak Hour in the year 2028. The calculated trips generated for an average weekday are expected to be 4,420 vehicles for the proposed development in 2028. No trip reductions were included in the analysis.

▪ TRIP DISTRIBUTION AND ASSIGNMENT:

Figures 6a and 6b show the projected distribution for traffic entering and exiting at the studied intersections. The percentages shown only pertain to the trips generated by the new proposed residential dwellings in the development calculated from the ITE Trip Generation Manual and shown in Table 5.

Typically, trip distribution and future traffic assignments are based on assuming likely traffic routes based on outside destinations and "attractors" and the resulting inbound and outbound traffic flows. However, Knox County Engineering directed that this study assume that all traffic generated by the subdivision will travel either east or west on North Ruggles Ferry Pike the entire length to its ends without deviation. This assumption results in all generated traffic by the subdivision being added to the volumes of North Ruggles Ferry Pike at Asheville Highway and Andrew Johnson Highway. This directive was requested to test a worst-case scenario of the two intersections' capacity at each end of North Ruggles Ferry Pike.



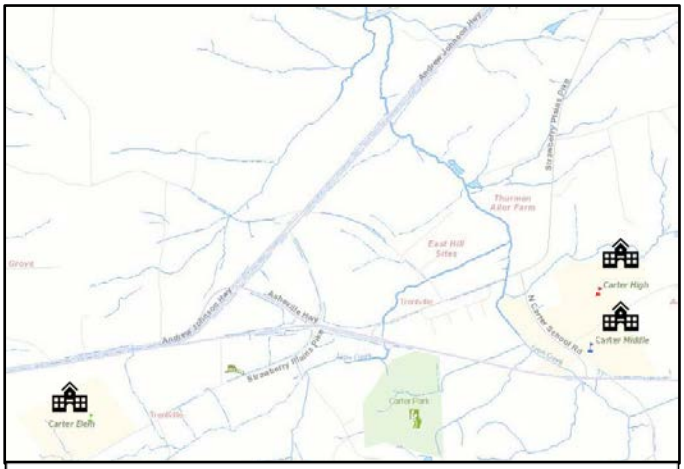
Google Route Direction Mapping to and from the West to Site

In reality, not all traffic generated by the subdivision will travel the full length of North Ruggles Ferry Pike, especially to and from the west. Several roads currently exist between North Ruggles Ferry Pike and Asheville Highway, which provides shorter travel times and distances, especially for travel to the west and also the south towards Strawberry Plains Pike and Interstate 40. In particular, Cash Road and North Patty Road off North Ruggles Ferry Pike are sensible routes that would result in travel time reductions instead of traveling the full length of North Ruggles Ferry Pike to the west. Obtaining directions from popular travel route applications, such as Waze and Google Maps, all recommend using Cash Road and North Patty Road in between Asheville Highway and North Ruggles Ferry Pike for travel to and from the proposed development site. Both roads are reasonably wide enough and appropriate for

residential passenger-vehicle travel.

Knox County Engineering's directives were followed by distributing and assigning the generated traffic volumes to each end of North Ruggles Ferry Pike. The assumed distribution of east and west travel (65% / 35% splits) was discerned and assumed based on the existing volumes during the AM and PM peak hours. The assumed distribution of traffic at each of the intersections is based on the existing observed turning movements at the intersection.

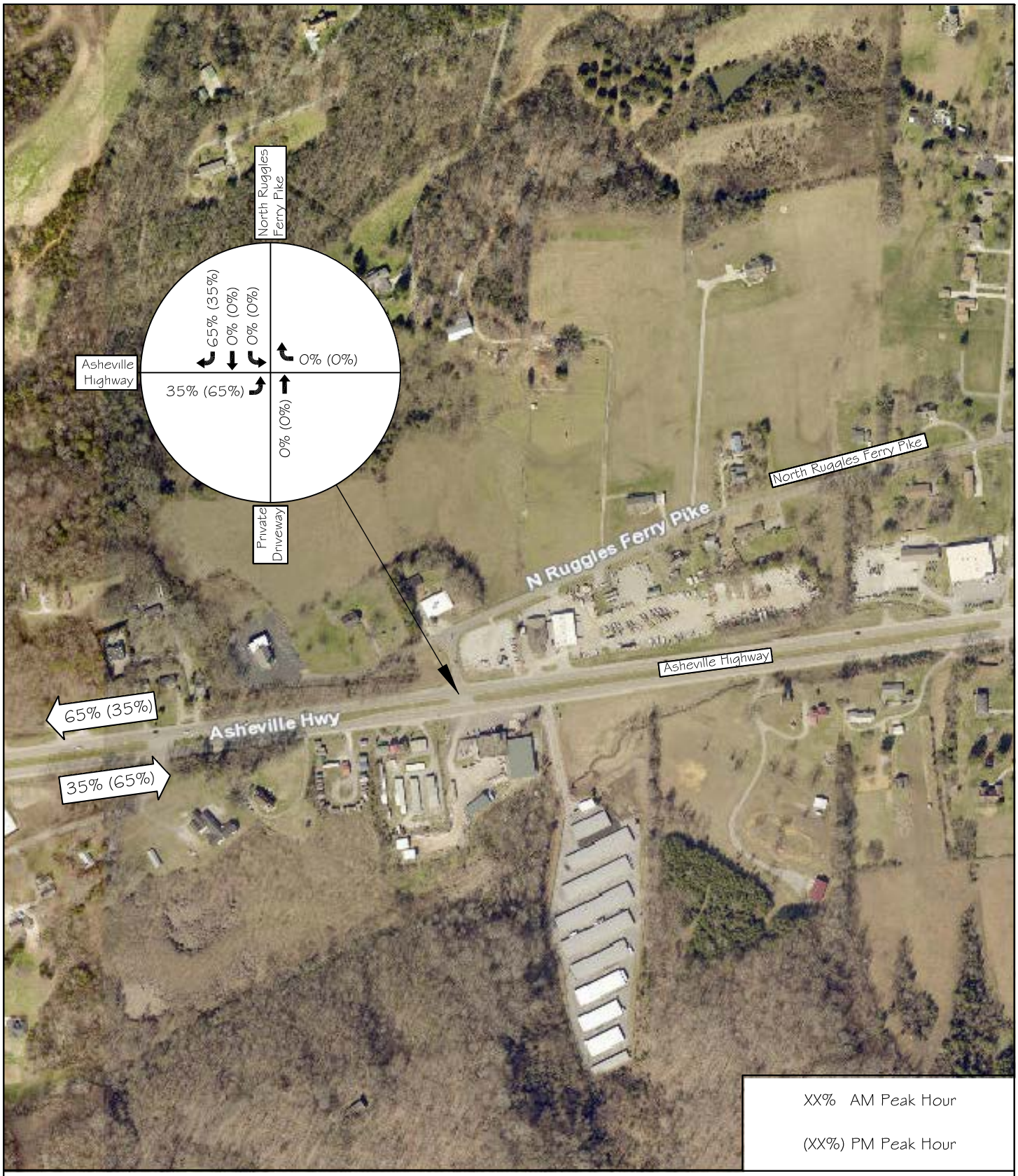
Various outside developments will potentially "attract" the projected generated traffic to and from the new residential subdivision. In addition to employment centers and commercial development, some traffic will travel to and from various public and private elementary, middle, and high schools. This site development property is currently zoned for Carter Elementary School, Carter Middle School, and Carter High School. All these public schools are to the south and east of the subdivision in the vicinity of the intersection of Asheville Highway and Andrew Johnson Highway.



Carter Elementary, Middle, and High School

The distribution of generated traffic entering the two subdivision entrances is based on the same assumed 65% / 35% directional east and west split of traffic on North Ruggles Ferry Pike. It is also further assumed that the generated trips will be split among the two entrances based on the internal lot distribution and road layout. A division line is shown in Figure 6b, which illustrates the assumed internal split of the generated traffic by the subdivision at the two entrances. This division line corresponds to the subdivision with a 65%/35% split based on 428 house lots. Based on this assumption, most of the traffic generated by the development will enter and exit at Road "A".

Figures 7a and 7b show the Traffic Assignment of the computed trips generated by the subdivision (from Table 5) and the application of the intersection turning movements volumes based on the assumed distribution of trips shown in Figures 6a and 6b.



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

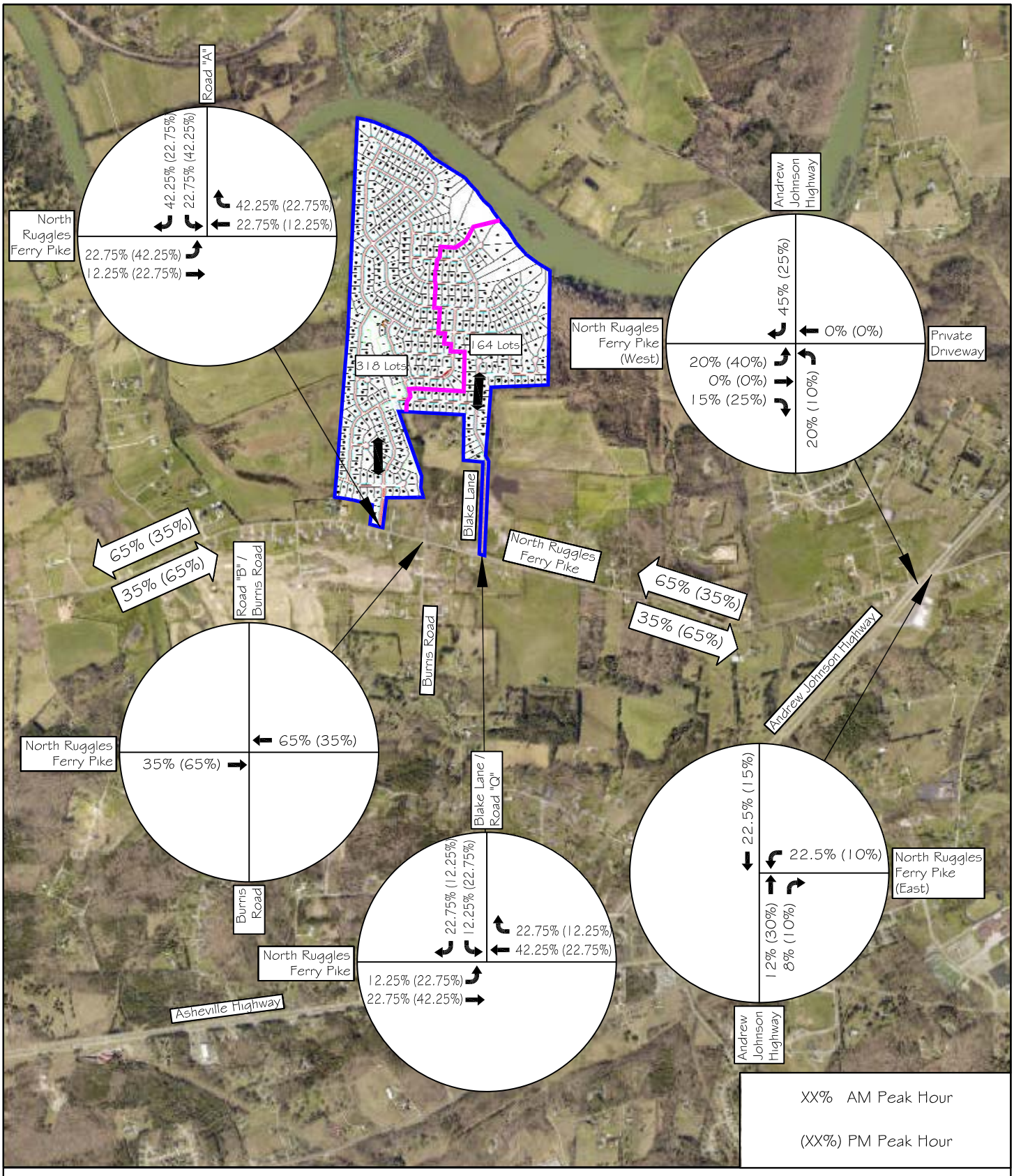
NOT TO SCALE

NORTH

FIGURE 6a

Innsbruck Farms

Directional Distribution of Generated Traffic during AM and PM Peak Hour



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

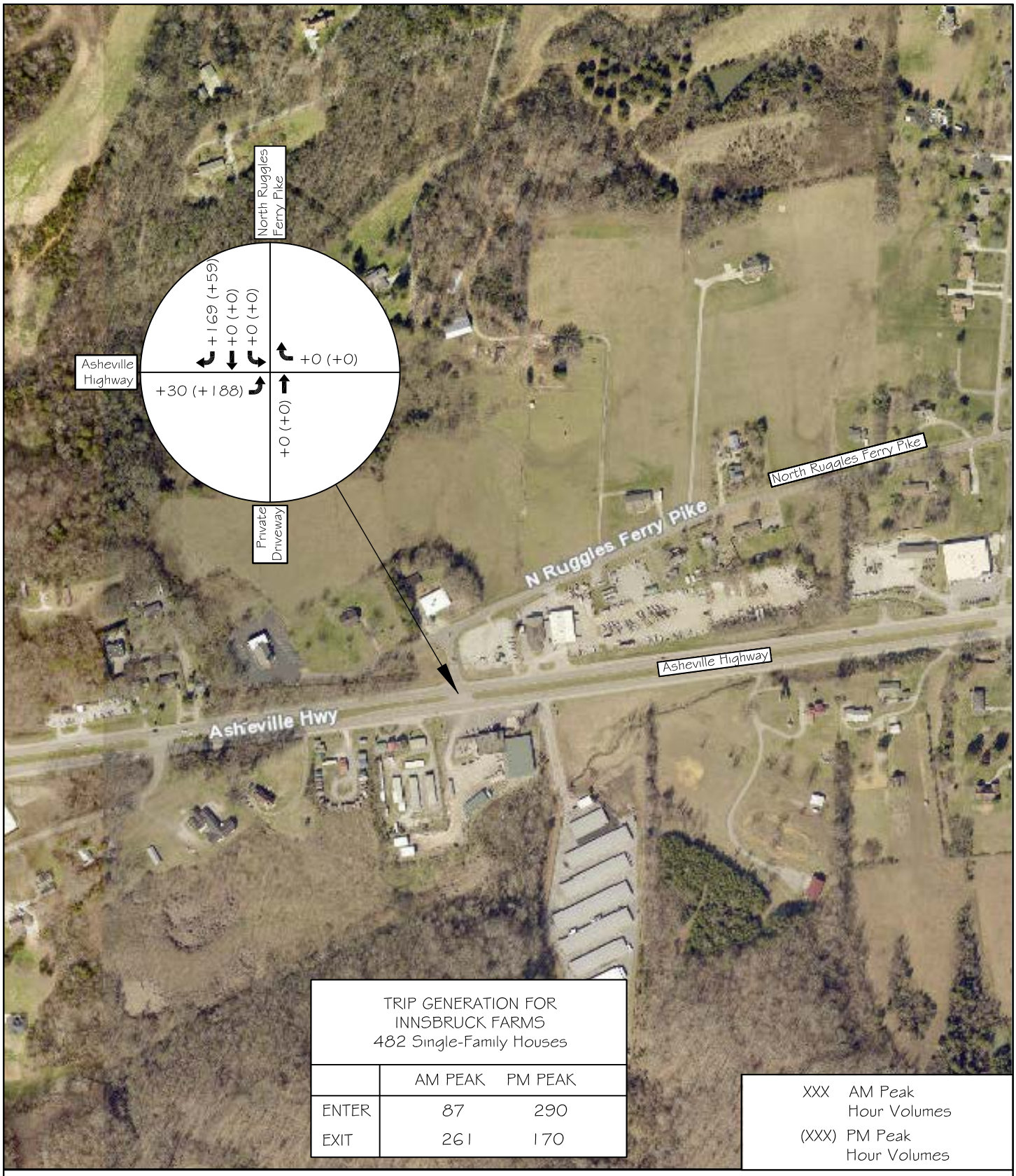
NOT TO SCALE

NORTH

FIGURE 6b

Innsbruck Farms

Directional Distribution of Generated Traffic during AM and PM Peak Hour



TRIP GENERATION FOR
INNSBRUCK FARMS
482 Single-Family Houses

	AM PEAK	PM PEAK
ENTER	87	290
EXIT	261	170

XXX AM Peak Hour Volumes
(XXX) PM Peak Hour Volumes

AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

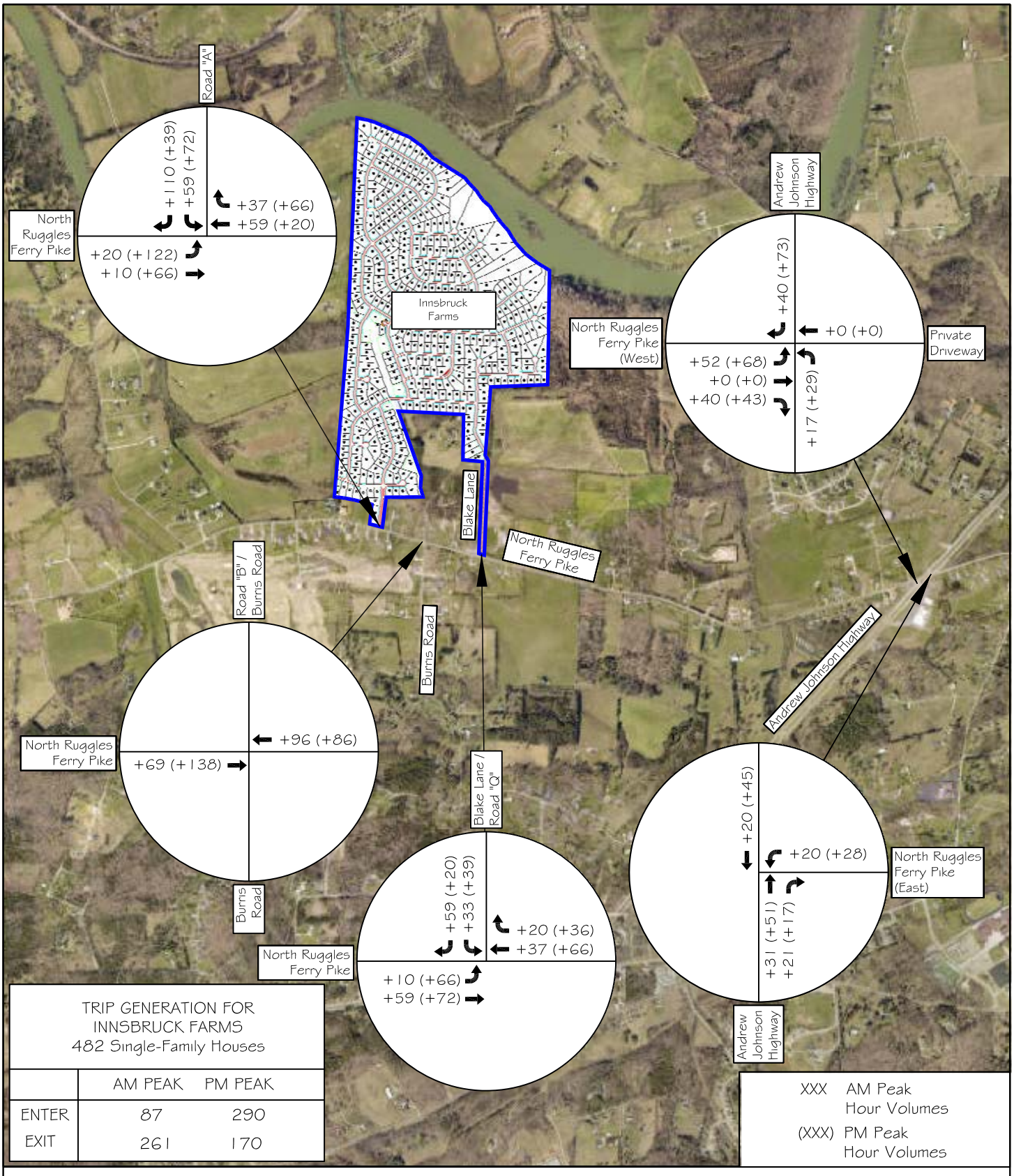
NOT TO SCALE

NORTH

FIGURE 7a

Innsbruck Farms

Traffic Assignment of Generated Traffic during AM and PM Peak Hour



TRIP GENERATION FOR
INNSBRUCK FARMS
482 Single-Family Houses

	AM PEAK	PM PEAK
ENTER	87	290
EXIT	261	170

XXX AM Peak Hour Volumes

(XXX) PM Peak Hour Volumes

AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

NOT TO SCALE

NORTH

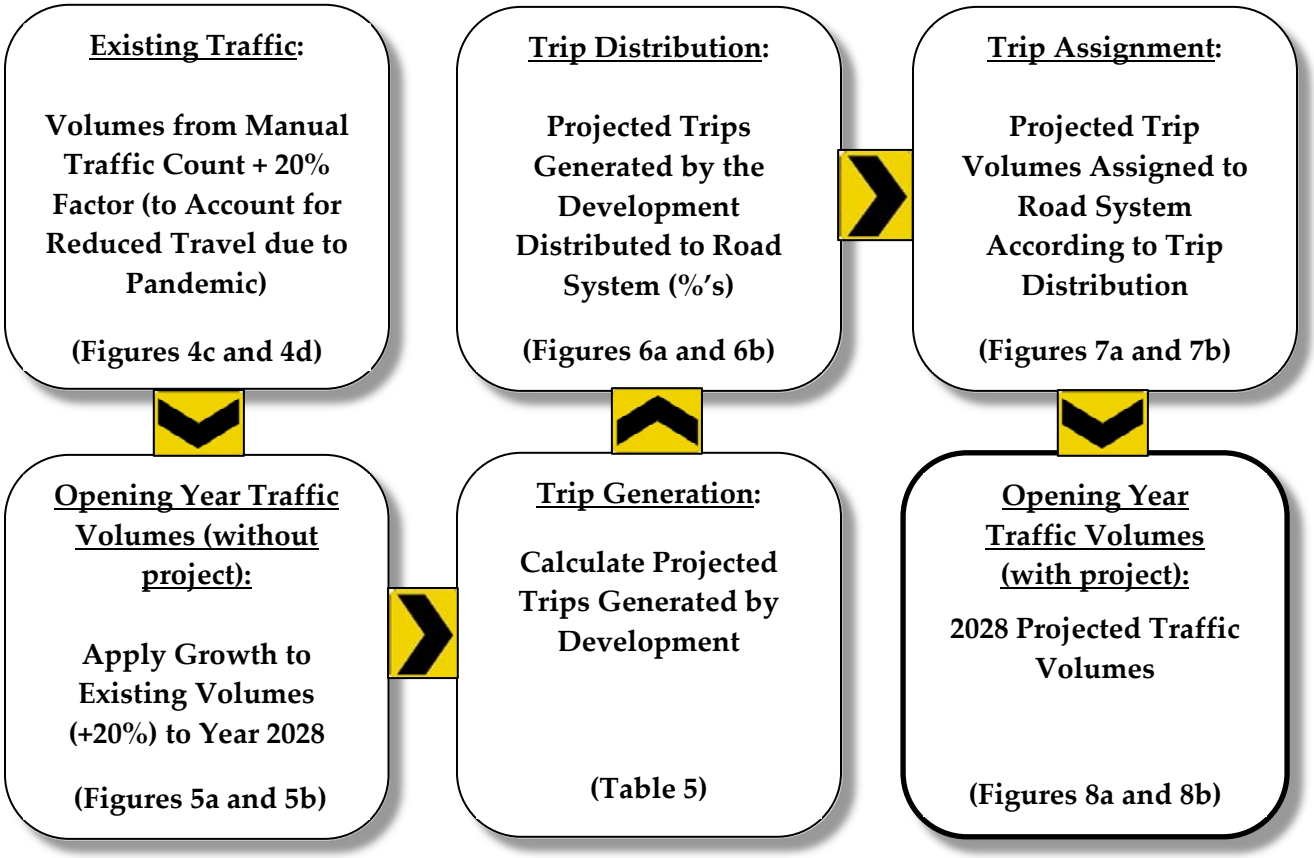
FIGURE 7b

Innsbruck Farms

Traffic Assignment of Generated Traffic during AM and PM Peak Hour

- **OPENING YEAR TRAFFIC CONDITIONS (WITH PROJECT):**

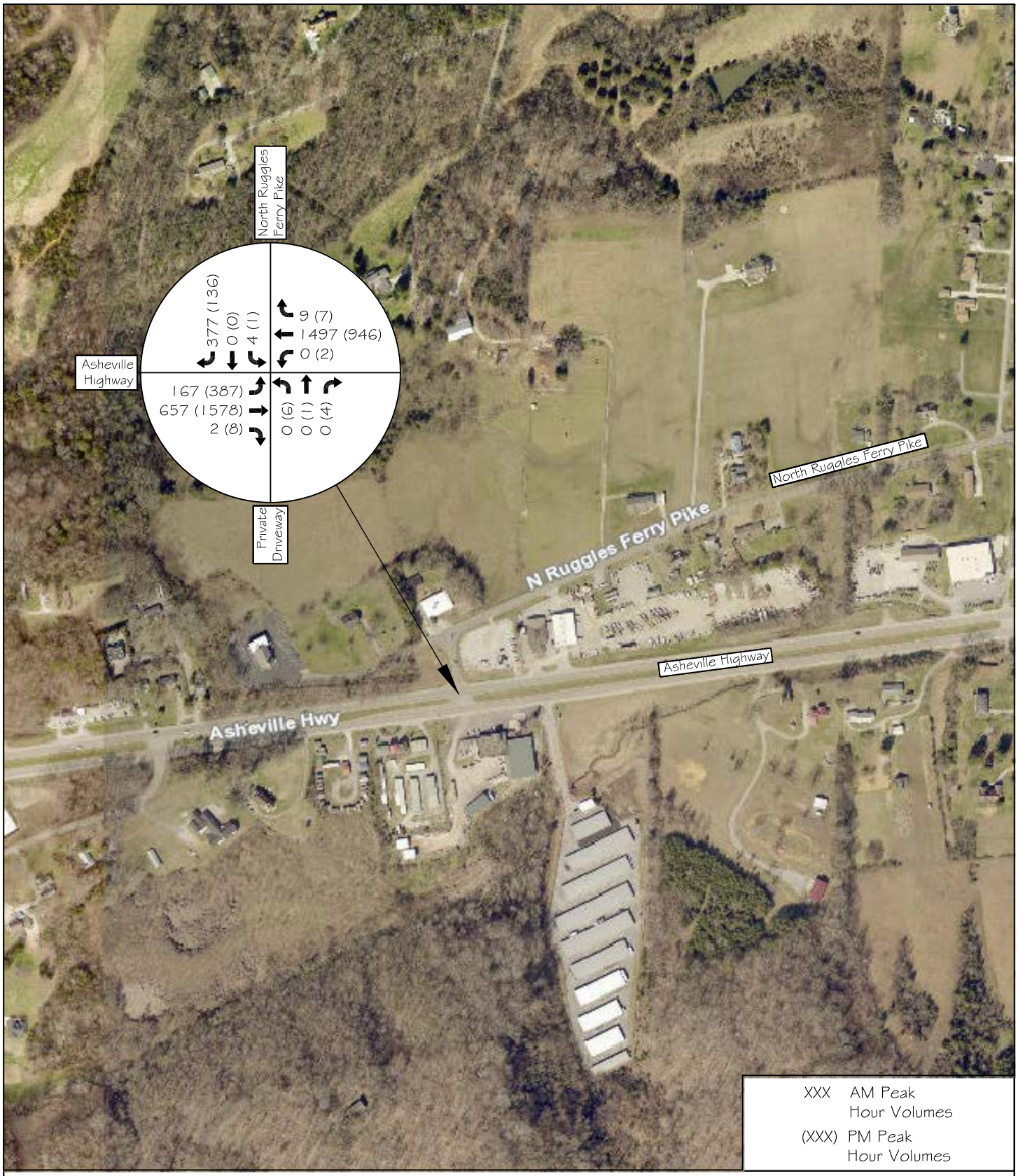
Overall, several additive steps were taken to estimate the total opening year projected traffic volumes at the studied intersections when the Innsbruck Farms Subdivision is entirely constructed and occupied by 2028. The steps are illustrated below for clarity:



To calculate the total future projected traffic volumes at the studied intersections, the calculated peak hour traffic (from ITE Trip Generation) generated by the new Innsbruck Farms Subdivision was added to the 2028 opening year traffic (Figures 5a and 5b) by following the predicted directional distributions and assignments (Figures 6a, 6b, 7a, and 7b). This procedure was completed to obtain the total projected traffic volumes when the development is fully built-out and occupied in 2028. Figures 8a and 8b show the projected AM and PM peak hour volumes at the studied intersections for 2028 with the development traffic.

All the above assumptions are based on the directive that all generated trips by the development were to be assigned and distributed to each end of North Ruggles Ferry Pike. The thru volumes

at the intersection of North Ruggles Ferry Pike at Blake Lane were determined based on the volumes from the intersection of North Ruggles Ferry Pike at Burris Road. The entering and exiting volumes on Blake Lane during the AM and PM peak hours were assumed to be the same as collected on the north side of Burris Road since there are a similar number of homes and properties on each road. This assumption was necessary since a traffic count was not conducted at the intersection of North Ruggles Ferry Pike at Blake Lane.



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

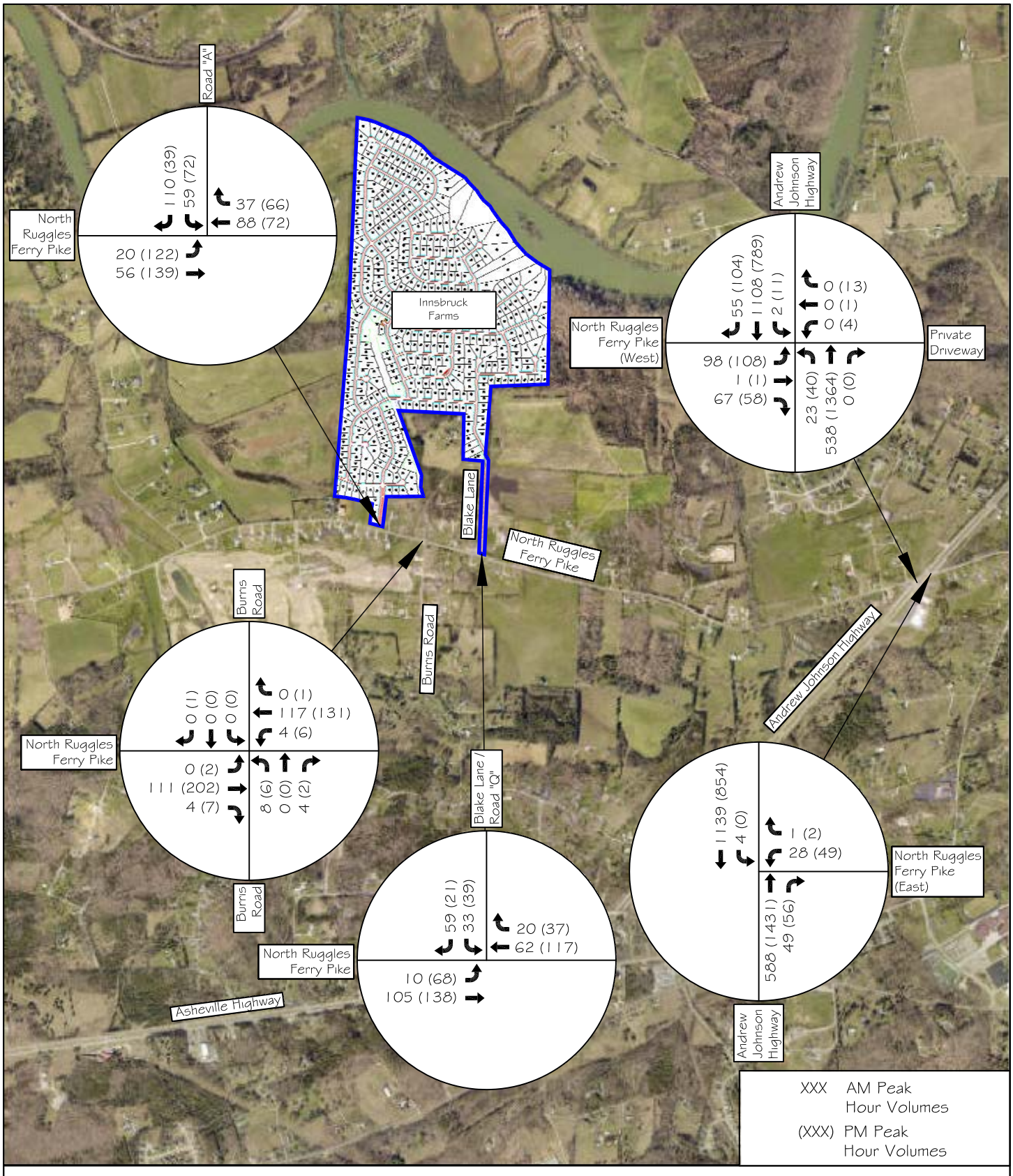
NOT TO SCALE

NORTH

FIGURE 8a

Innsbruck Farms

2028 Peak Hour Traffic Volumes - OPENING YEAR TRAFFIC (WITH PROJECT)



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

NOT TO SCALE

NORTH

FIGURE 8b

Innsbruck Farms

2028 Peak Hour Traffic Volumes - OPENING YEAR TRAFFIC (WITH PROJECT)

Capacity analyses were conducted to determine the projected Level of Service for vehicles at the existing and proposed intersection with the development traffic in the year 2028. Appendix F includes the worksheets for these capacity analyses.

As expected, the additional traffic generated from the proposed residential subdivision increased the already calculated extreme vehicle delays in the year 2028 (without the project). It resulted in intolerable vehicle delays for the minor approaches off North Ruggles Ferry Pike at Asheville Highway and Andrew Johnson Highway. However, the subdivision entrances, Road "A" and Blake Lane/Road "Q" are calculated to operate very well with respect to Level of Service and will have minimal vehicle delays. The projected 2028 peak hour vehicular traffic results at the studied intersections can be seen in Table 6 for the AM and PM peak hours.

Summaries of the intersection analysis results are presented in Tables 7a thru 7d. Graphs of the results follow the tables highlighting the LOS results. These tables provide a side-by-side summary of each intersection: for the 2021 existing conditions (+ 20%), the projected conditions in the year 2028 without the project, and the projected conditions in the year 2028 with the project. (Note: The North Ruggles Ferry Road at Road "A" and the North Ruggles Ferry Road at Blake Lane/Road "Q" intersection are not included in the summary tables since these intersections only occur in the analysis of the projected 2028 conditions.)

TABLE 6
2028 UNSIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS - OPENING YEAR (2028 WITH PROJECT)

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Asheville Highway at North Ruggles Ferry Pike	STOP Unsignalized	Eastbound Left	E	42.3	0.750	D	31.4	0.780
		Westbound Left	-	0.0	0.000	A	0.7	0.020
		Northbound Left/Thru/Right	A	0.0	0.000	F	Err	12.350
		Southbound Left/Thru/Right	F	600.6	2.230	F	167.1	1.100
Andrew Johnson Highway at North Ruggles Ferry Pike (West Side)	STOP Unsignalized	Eastbound Left/Thru/Right	F	Err	3.690	F	Err	5.400
		Westbound Left/Thru/Right	A	0.0	0.000	F	192.6	0.740
		Northbound Left	C	15.1	0.160	B	11.4	0.150
		Southbound Left	A	0.2	0.010	A	1.8	0.060
Andrew Johnson Highway at North Ruggles Ferry Pike (East Side)	STOP Unsignalized	Westbound Left/Right	F	59.0	0.490	F	336.5	1.270
		Southbound Left	A	0.2	0.010	-	0.0	0.000
North Ruggles Ferry Pike at Burris Road	STOP Unsignalized	Eastbound Left/Thru/Right	-	0.0	0.000	A	0.1	0.000
		Westbound Left/Thru/Right	A	0.2	0.000	A	0.8	0.010
		Northbound Left/Thru/Right	B	10.9	0.030	B	11.9	0.030
		Southbound Left/Thru/Right	A	0.0	0.000	A	9.1	0.000
North Ruggles Ferry Pike at Road "A"	STOP Unsignalized	Eastbound Left/Thru	A	2.1	0.020	A	4.0	0.090
		Southbound Left/Right	B	10.3	0.220	B	13.3	0.220
North Ruggles Ferry Pike at Blake Lane/Road "Q"	STOP Unsignalized	Eastbound Left/Thru	A	0.6	0.010	A	2.7	0.050
		Southbound Left/Right	A	10.0	0.120	B	11.9	0.110

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections

[a] Level of Service

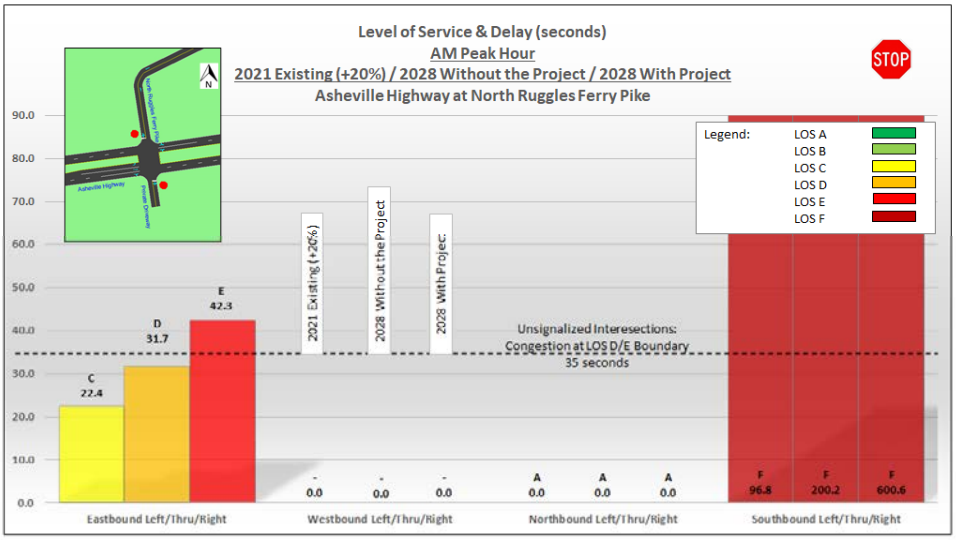
[b] Average Delay (sec/vehicle)

[c] Volume-to-Capacity Ratio

TABLE 7a
INTERSECTION CAPACITY ANALYSIS SUMMARY
ASHEVILLE HIGHWAY AT NORTH RUGGLES FERRY PIKE

LOCATION / PEAK HOUR MOVEMENT	2021 EXISTING (+20%)			2028 WITHOUT THE PROJECT			2028 WITH PROJECT		
	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]
Asheville Highway at North Ruggles Ferry Pike STOP									
AM Peak									
Eastbound Left/Thru/Right	C	22.4	0.480	D	31.7	0.620	E	42.3	0.750
Westbound Left/Thru/Right	-	0.0	0.000	-	0.0	0.000	-	0.0	0.000
Northbound Left/Thru/Right	A	0.0	0.000	A	0.0	0.000	A	0.0	0.000
Southbound Left/Thru/Right	F	96.8	1.010	F	200.2	1.290	F	600.6	2.230
PM Peak									
Eastbound Left	B	13.8	0.330	C	16.0	0.400	D	31.4	0.780
Westbound Left	A	0.5	0.020	A	0.7	0.020	A	0.7	0.020
Northbound Left/Thru/Right	F	90.8	0.260	F	219.0	0.520	F	Err	12.350
Southbound Left/Thru/Right	C	17.3	0.220	C	19.9	0.270	F	167.1	1.100

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio



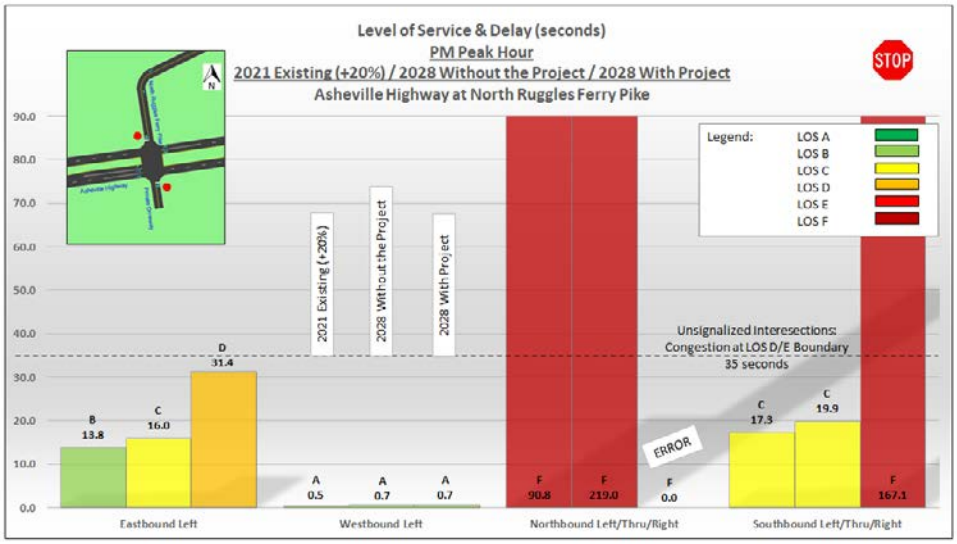
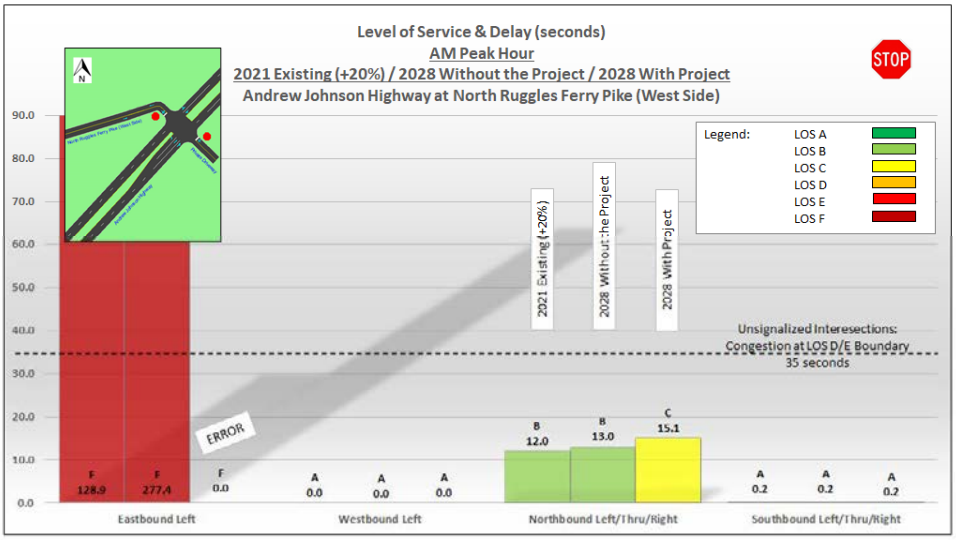


TABLE 7b
INTERSECTION CAPACITY ANALYSIS SUMMARY
ANDREW JOHNSON HIGHWAY AT NORTH RUGGLES FERRY PIKE (WEST SIDE)

LOCATION / PEAK HOUR MOVEMENT	2021 EXISTING (+20%)			2028 WITHOUT THE PROJECT			2028 WITH PROJECT		
	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]
Andrew Johnson Highway at North Ruggles Ferry Pike (West Side)				STOP					
AM Peak									
Eastbound Left	F	128.9	0.860	F	277.4	1.250	F	Err	3.690
Westbound Left	A	0.0	0.000	A	0.0	0.000	A	0.0	0.000
Northbound Left/Thru/Right	B	12.0	0.030	B	13.0	0.040	C	15.1	0.160
Southbound Left/Thru/Right	A	0.2	0.010	A	0.2	0.010	A	0.2	0.010
PM Peak									
Eastbound Left	F	142.4	0.810	F	325.7	1.260	F	Err	5.400
Westbound Left	F	51.0	0.300	F	77.6	0.430	F	192.6	0.740
Northbound Left/Thru/Right	A	9.7	0.030	B	10.1	0.040	B	11.4	0.150
Southbound Left/Thru/Right	A	1.4	0.050	A	1.8	0.060	A	1.8	0.060

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio



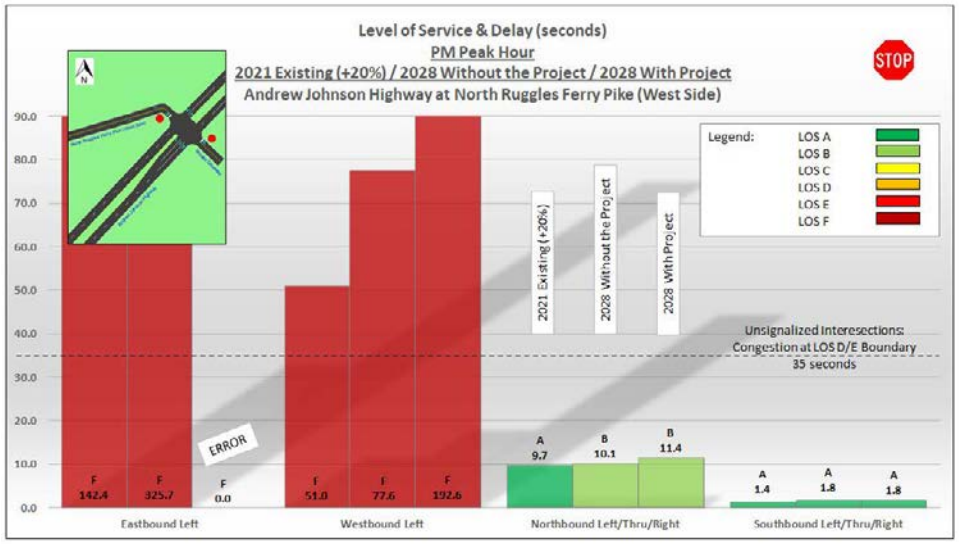
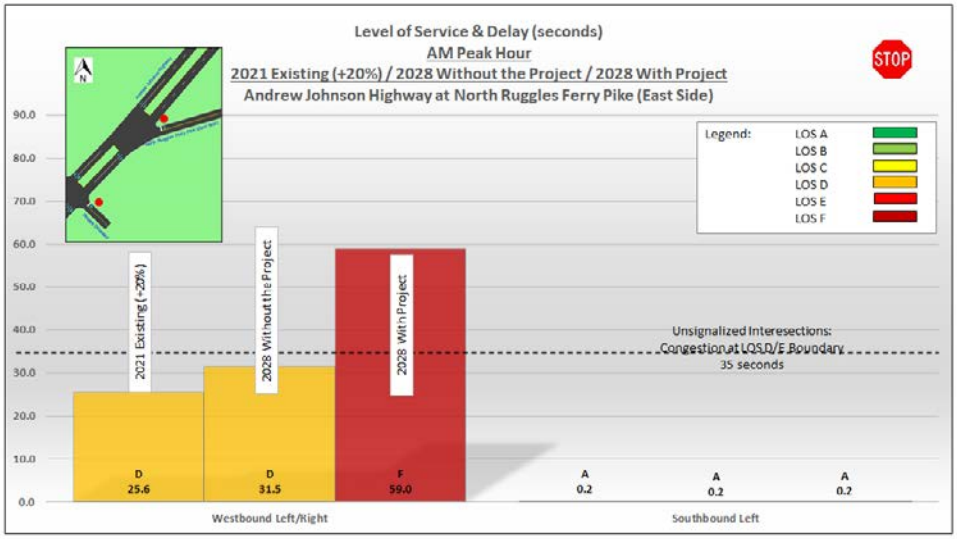


TABLE 7c
INTERSECTION CAPACITY ANALYSIS SUMMARY
ANDREW JOHNSON HIGHWAY AT NORTH RUGGLES FERRY PIKE (EAST SIDE)

LOCATION / PEAK HOUR MOVEMENT	2021 EXISTING (+20%)			2028 WITHOUT THE PROJECT			2028 WITH PROJECT		
	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]
Andrew Johnson Highway at North Ruggles Ferry Pike (East Side)				STOP					
AM Peak									
Westbound Left/Right	D	25.6	0.090	D	31.5	0.130	F	59.0	0.490
Southbound Left	A	0.2	0.010	A	0.2	0.010	A	0.2	0.010
PM Peak									
Westbound Left/Right	F	60.9	0.330	F	96.9	0.490	F	336.5	1.270
Southbound Left	-	0.0	0.000	-	0.0	0.000	-	0.0	0.000

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio



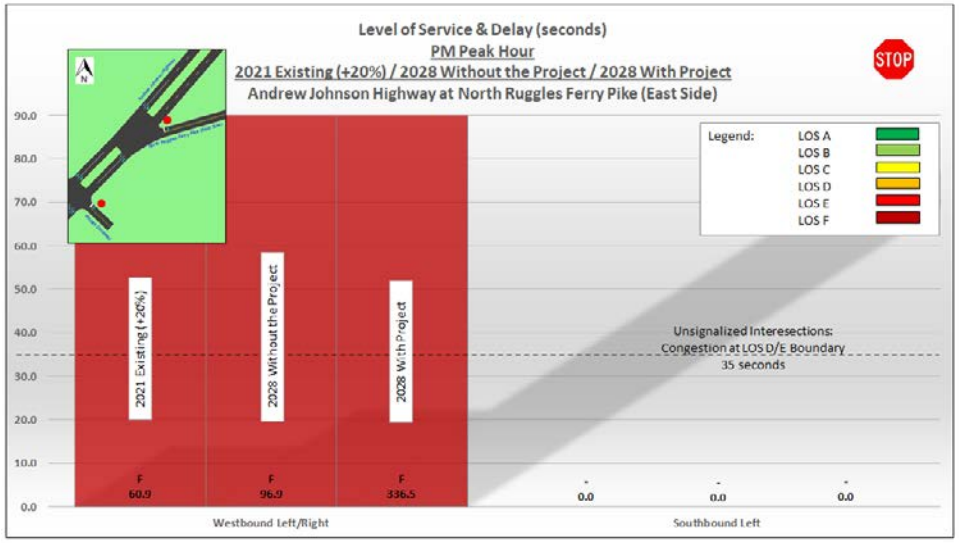
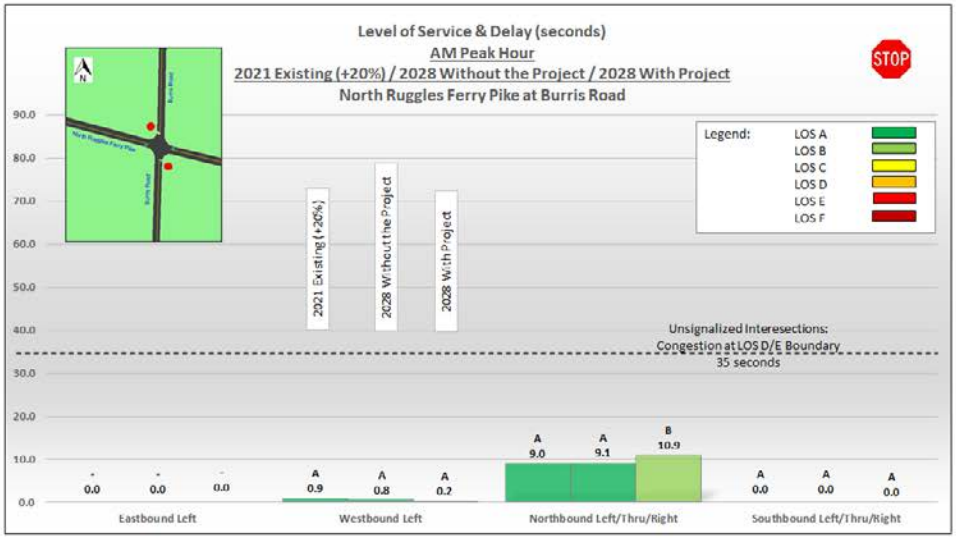
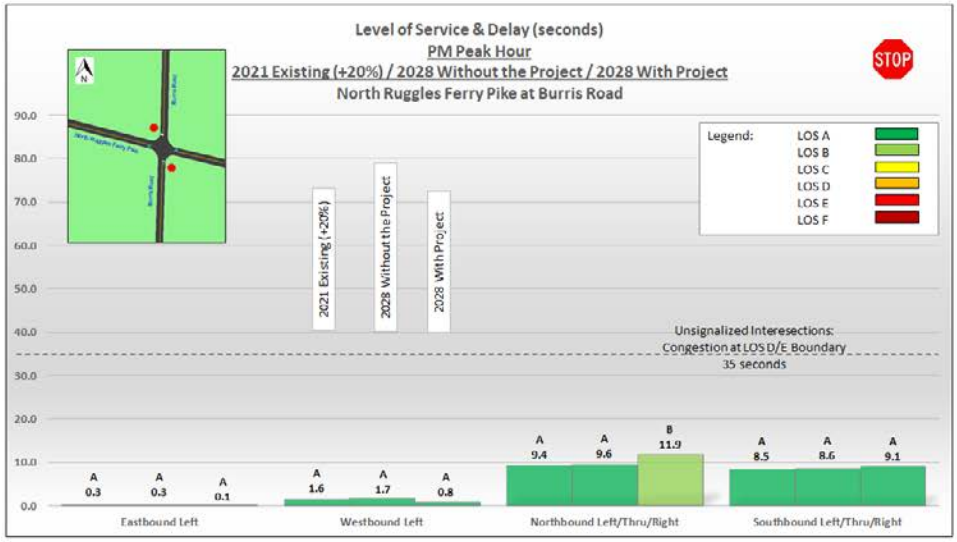


TABLE 7d
INTERSECTION CAPACITY ANALYSIS SUMMARY
NORTH RUGGLES FERRY PIKE AT BURRIS ROAD

LOCATION / PEAK HOUR MOVEMENT	2021 EXISTING (+20%)			2028 WITHOUT THE PROJECT			2028 WITH PROJECT		
	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]	LOS[a]	Delay[b]	v/c[c]
North Ruggles Ferry Pike at Burris Road			STOP						
AM Peak									
Eastbound Left	-	0.0	0.000	-	0.0	0.000	-	0.0	0.000
Westbound Left	A	0.9	0.000	A	0.8	0.000	A	0.2	0.000
Northbound Left/Thru/Right	A	9.0	0.020	A	9.1	0.020	B	10.9	0.030
Southbound Left/Thru/Right	A	0.0	0.000	A	0.0	0.000	A	0.0	0.000
PM Peak									
Eastbound Left	A	0.3	0.000	A	0.3	0.000	A	0.1	0.000
Westbound Left	A	1.6	0.010	A	1.7	0.010	A	0.8	0.010
Northbound Left/Thru/Right	A	9.4	0.020	A	9.6	0.020	B	11.9	0.030
Southbound Left/Thru/Right	A	8.5	0.000	A	8.6	0.000	A	9.1	0.000

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for unsignalized intersections
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio





▪ POTENTIAL SAFETY ISSUES:

The study area was investigated for potential existing and future safety issues. A couple of features of the adjacent transportation system are discussed in the following pages.

☛ EVALUATION OF TURN LANE THRESHOLDS

An evaluation of the need for separate turn lanes for entering vehicles into the development in 2028 was conducted at the subdivision entrances on North Ruggles Ferry Pike at Road "A" and Blake Lane/Road "Q". The design policy used for these turn lane evaluations is based on "Knox County's Access Control and Driveway Design Policy". This design policy relates vehicle volume thresholds based on prevailing speeds for two-lane and four-lane roadways. This Knox County policy is based on TDOT and nationally accepted guidelines for unsignalized intersections.

Based on the projected 2028 AM and PM Peak Hour traffic volumes at the subdivision entrance intersections on North Ruggles Ferry Pike and the posted speed limit of 40-mph, the need for separate eastbound left-turn lanes or westbound right-turn lanes on North Ruggles Ferry Pike is not warranted. The worksheets for these evaluations are in Appendix H.

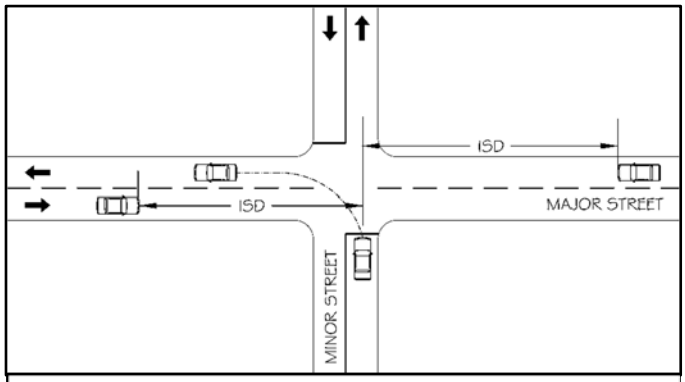
Based on KGIS mapping, the right-of-way width on North Ruggles Ferry Pike at the proposed entrance, Road "A", is 50 feet. This width appears to be sufficient for constructing an additional entering turn lane if required in the future. This may be necessary in the future if additional development phases are proposed for this subdivision, and a turn lane is warranted based on the increased traffic volumes. While property acquisition may not be necessary, the adjacent property's driveways would likely require re-construction to construct an entering turn lane.

☛ EVALUATION OF SIGHT DISTANCE

For intersections, sight distance evaluations have two categories: Stopping Sight Distance (SSD) and Intersection Sight Distance (ISD).

> *Methodology:*
> SSD is the distance required for a motorist to perceive, react, and the vehicle to come to a complete stop before colliding with an object in the road. For evaluating intersections, this object would be another vehicle entering the intersection from a minor street. SSD

can be considered the minimum visibility distance standard for evaluating the safety of an intersection.



Intersection Sight Distance Diagram

ISD is based on the time required to perceive, react, and complete the desired traffic maneuver once a motorist on a minor street decides to perform a traffic maneuver. Three traffic maneuvers are available for vehicles stopped on a minor street at a 4-way intersection: left-turn from the minor road, right-turn from the minor road, and a crossing maneuver from the minor road across the major road. For turns from the minor street, ISD is needed to allow a stopped motorist on a minor street to turn onto a major street without being overtaken by an approaching vehicle. The most critical (longest) ISD is for left-turns from the minor street. The ISD for this maneuver includes the time to turn left and to clear half of the intersection without conflicting with the oncoming traffic from the left and accelerating to the road's operating speed without causing the approaching vehicles from the right to reduce their speed substantially. SSD can be considered the desirable visibility distance standard for evaluating the safety of an intersection. SSD is generally more critical than ISD; however, the ISD must be at least the same distance or greater than SSD to provide safe operations at an intersection.

Based on a posted speed limit of 40-mph on North Ruggles Ferry Pike, the required intersection sight distance (ISD) is 400 feet looking each direction at the intersection of North Ruggles Ferry Pike at Road "A" and Blake Lane/Road "Q" based on Knox County policy of requiring 10 feet of sight distance per 1-mph of speed. Based on an existing 4% grade on North Ruggles Ferry Pike at Road "A" and a posted speed limit of 40-mph, the SSD is calculated to be 325 feet for eastbound and 285 feet for westbound vehicles. Based on an existing 4% grade on North Ruggles Ferry Pike at Blake Lane/Road "Q" and a posted speed limit of 40-mph, the SSD is calculated to be 285 feet for eastbound and 325 feet for westbound vehicles.

A cursory examination of the sight distances on North Ruggles Ferry Pike was undertaken. Based on visual observation, it appears that the intersection sight distances from the proposed Road

"A" location and Blake Lane/Road "Q" at North Ruggles Ferry Pike looking to the east and west are adequate. Using a Nikon Laser Rangefinder at the proposed location of Road "A", the intersection sight distance was estimated to be more than 999+ feet (limit of laser rangefinder) to the east. To the west, the intersection sight distance was estimated to be 600 feet. At Blake Lane/Road "Q", the intersection sight distance was estimated to be more than 999+ feet (limit of laser rangefinder) to the west and 700 feet to the east. There is an existing utility pole on the eastern side of the proposed Road "A" location at North Ruggles Ferry Pike. This pole could interfere with sight distance looking towards the east. This pole may be removed or relocated to construct Road "A". At Blake Lane/Road "Q", a hedgerow to the east could interfere with sight distance if it is not maintained. A licensed land surveyor should verify sight distances at Road "A" and Blake Lane/Road "Q".

Images of the existing sight distances are presented below with each intersection's respective required ISD and SSD.

View of Sight Distance on North Ruggles Ferry Pike at Proposed Entrance - Road "A" Intersection (Looking East)

View of Sight Distance on North Ruggles Ferry Pike at Proposed Entrance - Road "A" Intersection (Looking West)

View of Sight Distance on North Ruggles Ferry Pike at Proposed Entrance - Blake Lane/Road "Q" Intersection (Looking East)

View of Sight Distance on North Ruggles Ferry Pike at Proposed Entrance - Blake Lane/Road "Q" Intersection (Looking West)

CONCLUSIONS & RECOMMENDATIONS

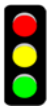
The following is an overview of recommendations to minimize the traffic impacts of the proposed development on the adjacent road system while attempting to achieve an acceptable traffic flow and safety level. Overall, North Ruggles Ferry Pike's minor approaches at Asheville Highway and Andrew Johnson Highway currently operate with high vehicle delays. The requirement of increasing the tabulated traffic volumes by 20% and distributing all generated trips to each end of North Ruggles Ferry Pike at Asheville Highway and Andrew Johnson Highway resulted in worse Levels of Service and extreme vehicle delays in the projected conditions.

Asheville Highway at North Ruggles Ferry Pike: This intersection was calculated to operate poorly in the existing conditions and worse in the projected conditions in 2028. As an investigation into potential remediation for this intersection, this intersection was examined with respect to traffic signal warrants.

Methodology:

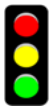
The Manual on Uniform Traffic Control Devices – 2009 Edition (MUTCD) presents nine different warrants that have been developed by the traffic engineering profession to determine whether a traffic signal is warranted. These warrants cover a broad range of minimum elements required to indicate whether a traffic signal is justified for any particular location. These elements consist of traffic volumes, pedestrian volumes, crash history, and other factors. The MUTCD explicitly states that a traffic control signal should not be installed unless one or more of the manual's signal warrants are met. However, the satisfaction of a warrant does not entirely in itself justify the need for a traffic signal. Sometimes further engineering studies and judgments also need to be applied before justifying the need for a traffic signal installation. These additional studies are a significant step in ensuring that a traffic signal's installation will not bring about degradations in safety and efficiencies.

The MUTCD defines nine different warrants, two of which are potentially applicable for this intersection at this time and are explained below:



Warrant #1, Eight-Hour Vehicular Volume:

Warrant #1 is comprised of 2 conditions – A and B. The Minimum Vehicular Volume, Condition A, is intended for application where the volume of intersecting traffic is the principal reason for consideration of signal installation. The Interruption of Continuous Traffic, Condition B, is intended for use at locations where Condition A is not satisfied and where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street.



Warrant #2, Four-Hour Vehicular Volume:

The Four-Hour Vehicular Volume signal warrant conditions are intended to be applied where the volume of intersecting traffic is the principal reason to consider installing a traffic control signal.

Even though nine warrants are offered to justify a traffic signal, according to the TDOT Traffic Signal Manual, the agency gives precedence to Warrant #1 (Eight Hour Vehicular Volume) and Warrant #7 (Crash Experience). Warrant #7 is based on Crash Experience. Even though Warrant #2 is not a primary warrant used by TDOT, it is included in this study. Furthermore, TDOT does not allow installing a traffic signal on a state route based on speculative developments or unrealized traffic volumes.

The intersection of Asheville Highway at North Ruggles Ferry Pike was evaluated for justification for a traffic signal based on the MUTCD Warrants listed above and the existing (+20% adjusted) traffic count volumes. North Ruggles Ferry Pike was used as the minor side street for the warrant analysis, and Asheville Highway was the major street. Warrant #7 was not analyzed at the intersections for this study. Warrant #7 was not included because one of the primary criteria for an intersection to meet the warrant is that an "Adequate trial of alternatives with satisfactory observance and enforcement has failed to reduce the crash frequency…" It is not believed that any specific alternatives have been implemented and observed at these intersections; therefore, this warrant was not included in this study.

According to the Federal Highway Administration (FHWA), the traffic signal warrants are intentionally written in a manner that provides a large amount of flexibility to engineers in terms of how they determine the number of moving lanes and the volume of approaching traffic used in the analysis. The decisions about which approach lanes on the major and minor streets and the corresponding traffic volumes are determined by the engineer's judgment conducting the study or by the methods established by local and state agencies. Ultimately, it is up to the reviewing agency to determine whether right-turn volumes from the minor street should be included.

This intersection currently meets Warrant #2 and nearly meets Warrant #1, Condition B, based on the existing traffic volumes with a 20% increase. This determination was made with the analysis including southbound right-turn volumes from North Ruggles Ferry Pike (the minor street approach). Since nearly all southbound traffic volumes from North Ruggles Ferry Pike comprise right-turn movements, it is deemed appropriate to include these traffic movements in the warrant analysis. Furthermore, Warrant #1, Condition B, is satisfied 7 out of the required 8 hours. Only an additional 11 right-turns would have been needed during the 11 am – 12 noon hour for the intersection to meet Warrant #1, Condition B fully, in addition to Warrant #2. Thus, it is appropriate to assume that this intersection can be justified for a traffic signal in the current existing conditions even before the residential subdivision is developed. Appendix I contains the traffic signal warrant assessment at this intersection for the existing 2021 volumes (with a +20% increase).

With the traffic signal warrant analysis indicating that this intersection could be justified to have a traffic signal installed, Synchro Traffic Software (Version 8) was used to design a preliminary traffic signalization plan. A preliminary traffic signal timing design resulted in a much-improved level of service for the intersection based on an optimized actuated-uncoordinated cycle in the AM and PM peak hours. The level of service results for this intersection with this preliminary traffic signal timing is shown in Tables 8a and 8b. Appendix F includes the worksheets for these capacity analyses and presents the initial traffic signal timing plans. Table 8a shows the intersection results of Asheville Highway at North Ruggles Ferry Pike with the existing traffic volumes (+20% increase). Table 8b reports the intersection results in the projected 2028 conditions with the project and generated traffic volumes operating under a traffic signal.

The poor results shown in Table 8b with a traffic signal are based on the directive that all the traffic volumes generated by the development to and from the west of the development are distributed via the Asheville Highway at North Ruggles Ferry Pike intersection without deviation. This scenario requires all subdivision traffic entering from the west to turn left onto North Ruggles Ferry Pike. All subdivision exiting traffic towards the west will turn right onto Asheville Highway. In this scenario, the Level of Service and vehicle delay results are poor in the AM hour, even with a traffic signal. The results are based on an optimized 110-second actuated uncoordinated cycle in the AM and PM peak hours. While the results are unsatisfactory, it is founded on the unreasonable assumption that all the residents would travel to and from the west via this intersection without exception and not seek alternate routes to avoid the high vehicle delays for eastbound left-turns and southbound right-turns at the intersection. In reality, subdivision residents would more likely utilize North Patty Road or Cash Road off North Ruggles Ferry Pike to avoid turning at the intersection and travel thru the intersection on Asheville Highway instead.

It is recommended that further traffic counts be conducted at this intersection when either the pandemic has ended and overall traffic volumes return closer to pre-pandemic levels, or when it is surmised that overall traffic volumes have reached a "new normal". This will allow for a re-examination of the intersection, a re-comparison of the Traffic Signal Warrants, and establish a timeframe of when this intersection could be signalized. TDOT does not allow a traffic signal installation on a state route based on speculative developments or unrealized traffic volumes. This process should be coupled with the knowledge that Innsbruck Farms Subdivision and other future developments along North Ruggles Ferry Pike will be adding vehicle traffic volumes at the intersection in the future conditions. Traffic crash data should also be included in the examination.

With the installation of a traffic signal at the intersection, the vehicle delays would decrease to manageable levels for the minor side street approaches. Without a traffic signal, even without the proposed development, the motorists from the minor side street approaches will continue to experience extensive delays during peak hours. Extreme delays can contribute to motorist impatience and increase reckless driving behavior, leading to traffic incidents.

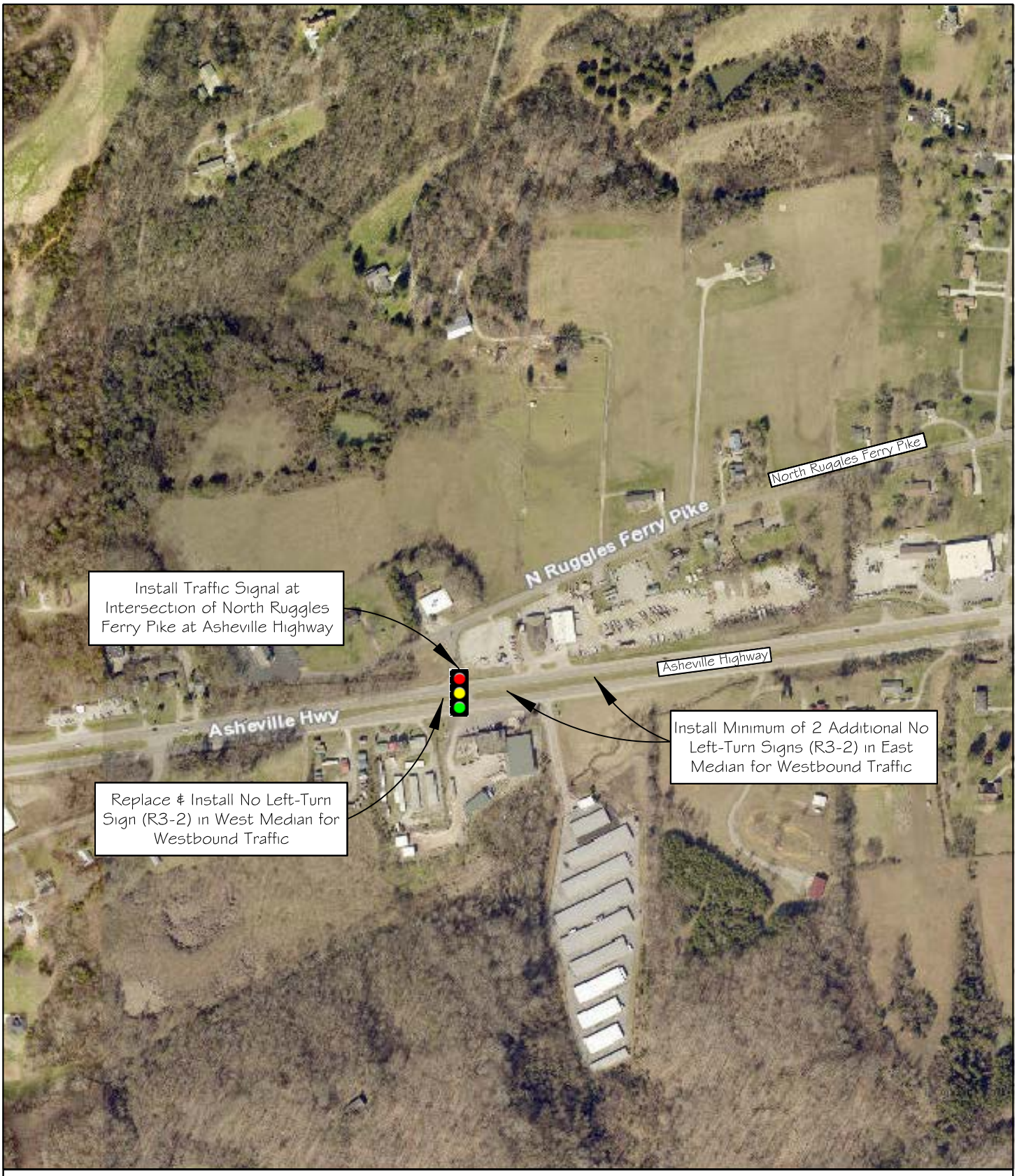
Any traffic signal design or other remediation should include determining whether the existing eastbound left-turn lane is sufficient in length with a traffic signal. It currently provides 150 feet of storage length. A cursory initial examination of the existing eastbound left-turn volumes (with the additional 20% increase) was made in the Synchro 8 software. The results showed that the 95th percentile queue length was 84 feet in the AM peak hour and 81 feet in the PM peak hour based on the existing (+20%) traffic volumes.

Since this intersection exists on a State Route, TDOT will need to provide direction and guidance to improve this intersection to reduce the considerable existing vehicle delays. The City of Knoxville will also need to be involved since they will assume ownership if a traffic signal is installed since this intersection lies within the city limits. TDOT does not own, operate, or maintain traffic signals, and the responsibility would belong to the local government.

A final recommendation for this intersection is regarding the prohibition of westbound left-turns from Asheville Highway to the Knox Farmers Cooperative parking lot. The existing sign (R3-2) stating this prohibition is dull and faded and should be more authoritatively presented. Several motorists were observed making this prohibited movement. This sign is recommended to be replaced with a new sign in the interim and supplemented with additional signage (minimum of 2 additional signs) located in the east median facing westbound traffic. Once the intersection is re-constructed with a traffic signal, this prohibition can be more pronounced by installing a sign on the span wire (or mast arm).

**Median of Asheville Highway
at North Ruggles Ferry Pike
(Looking West)**

A summary of the recommendations at this intersection is shown in Figure 9a.



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

NOT TO SCALE

NORTH

FIGURE 9a

Innsbruck Farms

Summary of Recommended External Road Improvements - Asheville Highway at North Ruggles Ferry Pike

TABLE 8a
2021 SIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS -
ASHEVILLE HIGHWAY AT NORTH RUGGLES FERRY PIKE
EXISTING TRAFFIC CONDITIONS (+20%)

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Asheville Highway at North Ruggles Ferry Pike	Signalized	Eastbound	A	9.4		A	4.9	
		Westbound	C	20.3		B	14.4	
		Northbound	A	0.0		C	22.0	
		Southbound	C	30.1		C	22.0	
		Summary	B	17.7	0.830	A	9.1	0.650

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for signalized intersections
Optimized Cycle Length = 75 Seconds
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

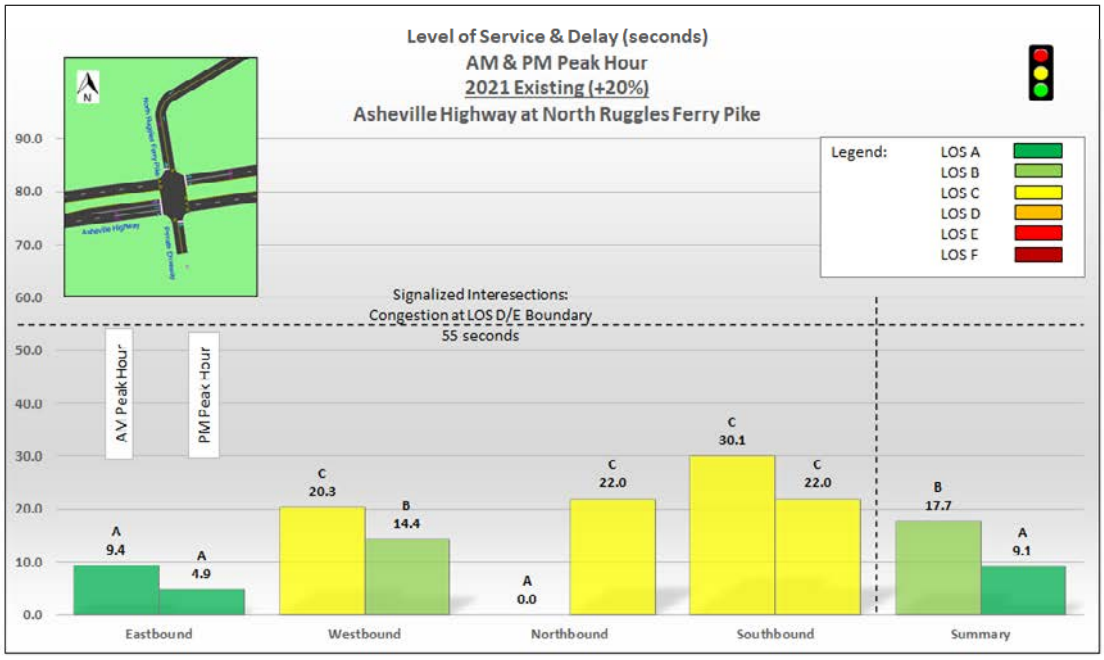
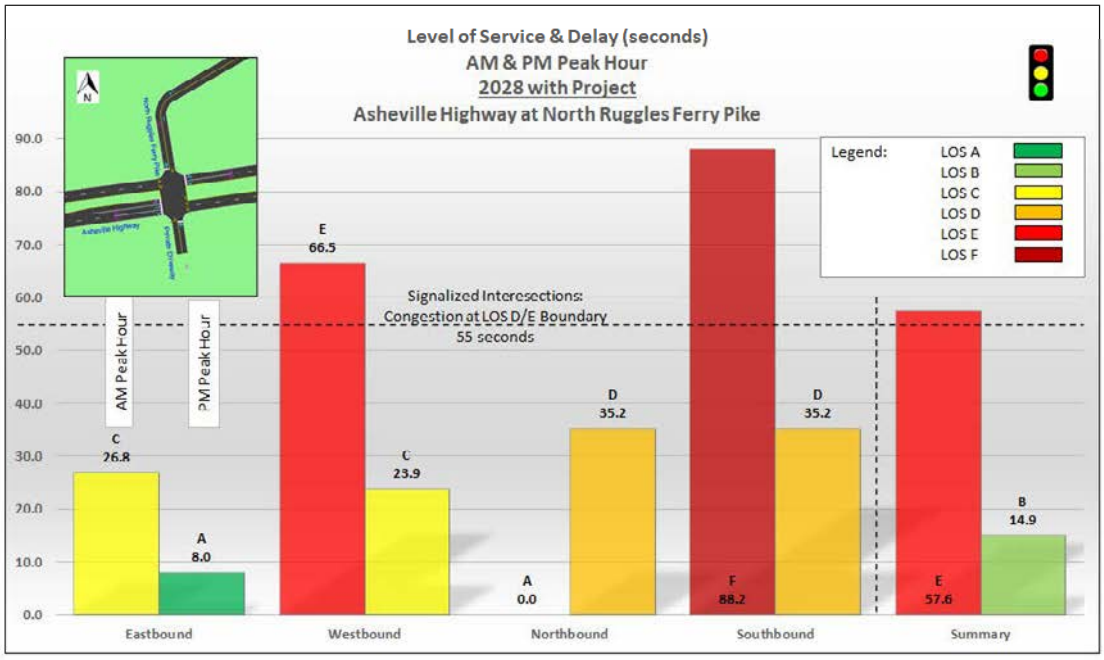


TABLE 8b
2028 SIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS -
ASHEVILLE HIGHWAY AT NORTH RUGGLES FERRY PIKE
OPENING YEAR (2028 WITH PROJECT)

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Asheville Highway at North Ruggles Ferry Pike	Signalized	Eastbound	C	26.8		A	8.0	
		Westbound	E	66.5		C	23.9	
		Northbound	A	0.0		D	35.2	
		Southbound	F	88.2		D	35.2	
		Summary	E	57.6	1.030	B	14.9	0.730

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for signalized intersections
Optimized Cycle Length = 110 Seconds
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio



2 **<u>Andrew Johnson Highway at North Ruggles Ferry Pike (East Side & West Side)</u>:** Both approaches of North Ruggles Ferry Pike (East Side and West Side) at Andrew Johnson Highway have been shown to operate very poorly with respect to Level of Service and with extreme vehicle delays in the existing conditions as well as the projected 2028 conditions. There are many operational issues with these existing intersections that will need to be addressed and are outside the impacts produced by the proposed Innsbruck Farms Subdivision.

This existing intersection is laid out in an extremely disadvantageous manner for motorists. Both sides of North Ruggles Ferry Pike intersect Andrew Johnson Highway at a sharp skewed angle of almost 30˚. This skew would be unacceptable for a newly constructed intersection. Most roadway design standards indicate intersection angles between 75˚ and 90˚ are desirable and angles between 60˚ and 75˚ degrees are acceptable. Angles less than 60˚ are sub-standard and produce operational issues and particularly sight distance issues. Both ends of North Ruggles Ferry Pike at Andrew Johnson Highway are laid out with short lengths of roadway attempting to intersect the highway at a more acceptable angle, albeit for about a single car length.

North Ruggles Ferry Pike (East Side) at Andrew Johnson Highway (Looking East)

North Ruggles Ferry Pike (West Side) at Andrew Johnson Highway (Looking East)

As stated previously, a fair amount of traffic was observed "crossing" Andrew Johnson Highway from one side of North Ruggles Ferry Pike to the other and vice versa. Most of the existing turn movements on each side of North Ruggles Ferry Pike are left-turns onto Andrew Johnson Highway. In the future, it is expected that entering and exiting traffic generated by the proposed subdivision (shown in Figure 6b) will contribute heavily to these volumes. These volume contributions will include left-turns from North Ruggles Ferry Pike (West Side) for travel towards Jefferson City, left-turns from North Ruggles Ferry Pike (West Side) for travel across ("thru") Andrew Johnson Highway to the other side of North Ruggles Ferry Pike (East Side) and vice versa. It was also previously shown that the existing level of service for these approaches of North Ruggles Ferry Pike is extremely poor with high vehicle delays.

The intersection of Andrew Johnson Highway at North Ruggles Ferry Pike (West Side) was also examined with respect to traffic signal warrants based on MUTCD Warrants for the existing (+20% adjusted) traffic volumes. Only North Ruggles Ferry Pike (West Side) was examined since the North Ruggles Ferry Pike (East Side) intersection has significantly fewer minor street volumes. For the traffic signal warrant analysis, North Ruggles Ferry Pike (West Side) was used as the minor side street, and Andrew Johnson Highway was the major street.

The analysis concluded that for the existing (+20% adjusted) traffic volumes, the intersection does not meet Warrant #1 or Warrant #2 even though the Level of Service calculations determined that the minor approaches at this intersection currently operate at LOS F during the AM and PM peak hour.

There are no easy or simple solutions for the existing conditions to reduce vehicle delays for this intersection. Remediation for the existing intersection is impeded due to many factors that include road geometrics, potentially limited right-of-way, many existing private driveways, and large thru volumes on Andrew Johnson Highway. Adding separate left-turn lanes on each side of North Ruggles Ferry Pike at Andrew Johnson Highway would decrease the delays for right-turn movements but will do little to decrease delays overall.

Since easily offered remediation is not readily apparent for this intersection, the intersection was re-examined with respect to traffic signal warrants. As stated previously,

TDOT does not typically accept justification for traffic signals except for Warrant #1 and #7. Warrant #7 was not examined for this study. Adding a traffic signal at this location would decrease vehicle delays for the minor street approach and potentially improve safety by reducing unprotected left-turns into the high thru volume streams on Andrew Johnson Highway. Another warrant, Warrant #3, is an alternative method to justify a traffic signal at this location. Warrant #3 is usually only used in rare instances such as locations near office complexes, manufacturing plants, etc. According to the MUTCD, Warrant #3 "is intended for use at a location where traffic conditions are such that for a minimum of 1 hour of an average day, the minor-street traffic suffers undue delay when entering or crossing the major street."

Warrant #3, Condition A, was met for the intersection of Andrew Johnson Highway at North Ruggles Ferry Pike (West Side) for the existing (+20% adjusted) traffic volumes. Appendix I shows the traffic signal warrant assessment at this intersection for the existing volumes of 2021 (with a +20% increase).

Outside of allowing the intersection to be currently signalized based on meeting Warrant #3, the intersection was further analyzed to determine when the volumes would justify a traffic signal based on Warrant #1. A spreadsheet was developed to determine the traffic volumes generated by the development being added to the intersection of Andrew Johnson Highway at North Ruggles Ferry Pike (West Side) based on the traffic distribution shown previously. This spreadsheet is provided in Appendix I. It is estimated that this intersection will meet Warrant #1, Condition B, and Warrant #2 in the year 2022. This estimation is based on the existing (+20%) traffic volumes and assuming a linear growth of home construction and occupancy in the subdivision over the seven years (slightly over 60 houses per year). This small length of time from not meeting Warrant #1 and #2 to potentially meeting the warrants is due to assuming the development will add 60 homes with residents with a subsequent 631 generated daily trips in the first year of construction (2022). Distributing and assigning a portion of those new trips at the intersection results in meeting the warrant thresholds.

With the traffic signal warrant analysis indicating that this intersection could be justified to have a traffic signal installed, Synchro Traffic Software (Version 8) was used to design a preliminary traffic signalization plan. A preliminary traffic signal timing design resulted in a much-improved level of service for the intersection based on an optimized

actuated-uncoordinated cycle in the AM and PM peak hours. The level of service results for this intersection with this preliminary traffic signal timing is shown in Tables 9a and 9b. Appendix F includes the worksheets for these capacity analyses and presents the initial traffic signal timing plans. Table 9a shows the intersection results of Andrew Johnson Highway at North Ruggles Ferry Pike with the existing traffic volumes (+20% increase). Table 9b reports the intersection results in the projected 2028 conditions with the project and generated traffic volumes operating under a traffic signal.

The results shown in Table 9b are based on the directive that all the traffic volumes generated by the development to and from the east of the development be distributed via the Andrew Johnson Highway at North Ruggles Ferry Pike (West Side) intersection without deviation. Unlike the opposite end of North Ruggles Ferry Pike at Asheville Highway, it is expected and reasonable to believe that all traffic to and from the east of the development will travel through this intersection since there are no sensible alternative routes of travel or shortcuts. As observed in the manual traffic counts, there is a reasonable amount of traffic that travels from North Ruggles Ferry Pike towards Jefferson City and across ("thru") Andrew Johnson Highway towards Strawberry Plains Pike and vice versa. The manual traffic count observation was documented evidence of an existing traffic pattern, which would be expected to continue and increase when new trips are generated from the subdivision in the future.

Similar to the previous recommendations for the intersection of Asheville Highway at North Ruggles Ferry Pike, it is recommended that further traffic counts be conducted again at this intersection when either the pandemic has ended and overall traffic volumes return closer to pre-pandemic levels, or when it is surmised that overall traffic volumes have reached a "new normal". TDOT does not allow a traffic signal installation on a state route based on speculative developments or unrealized traffic volumes. This will allow for a re-examination of the intersection, a re-comparison of the Traffic Signal Warrants, and establish a timeframe of when this intersection could be signalized. Traffic crash data should also be included in the examination.

Also, during the planning phase for a traffic signal at the intersection of Andrew Johnson Highway at North Ruggles Ferry Pike, it is recommended that the eastbound approach of North Ruggles Ferry Pike be examined whether an exclusive right-turn lane should be provided. Adding an exclusive lane would allow for the separation of left and right-turn

movements.

With the installation of a traffic signal at the intersection, the vehicle delays would decrease to manageable levels for the minor side street approaches. Without a traffic signal, even without the proposed development, the motorists from the minor side street approaches will continue to experience considerable delays during peak hours. High delays can contribute to motorist impatience and increase reckless driving behavior, leading to traffic incidents.

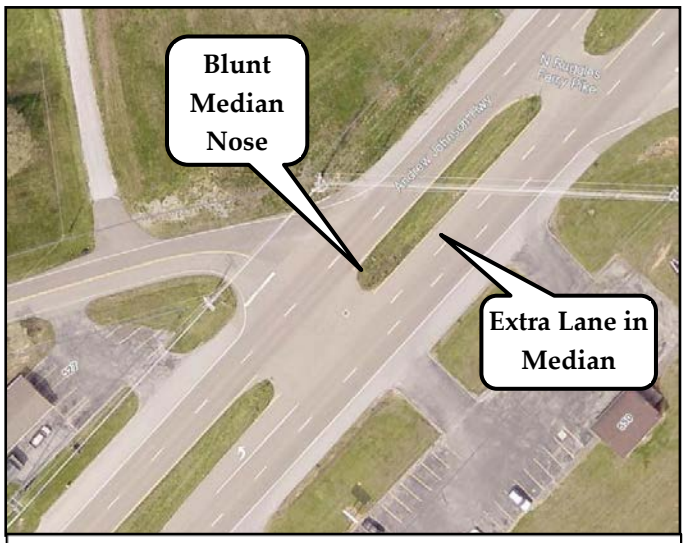
Any traffic signal design or other remediation should include determining whether the existing northbound left-turn lane is sufficient in length with a traffic signal. It currently provides 75 feet of storage length. A cursory initial examination of the existing northbound left-turn volumes (with the additional 20% increase) was made in the Synchro 8 software. The results showed that the 95th percentile queue length was 20 feet in the AM peak hour and 24 feet in the PM peak hour based on the existing (+20%) traffic volumes.

Since this intersection exists on a State Route, TDOT will need to provide direction and guidance to improve this intersection to reduce the considerable existing vehicle delays. Knox County will also need to be involved since they will assume ownership if a traffic signal is installed since this intersection lies within the county limits. TDOT does not own, operate, or maintain traffic signals, and the responsibility would belong to the local government.

The intersection of Andrew Johnson Highway at North Ruggles Ferry Pike (East Side) was not included in the proposed preliminary traffic signal recommendation for the Andrew Johnson Highway at North Ruggles Ferry Pike (West Side). The exclusion is due to North Ruggles Ferry Pike (East Side) having significantly lower traffic volumes and operating as a t-intersection with fewer conflicting movements than the 4-way intersection of North Ruggles Ferry Pike (West Side). Installing a traffic signal at North Ruggles Ferry Pike (West Side) would create significantly more traffic gaps to allow for westbound turning movements from North Ruggles Ferry Pike (East Side). To incorporate both these intersections under a unified, coordinated traffic signal control would require careful consideration and could result in additional vehicle delays and reduced capacities since these two intersections are separated by approximately 250 feet. For this design to work correctly and safely at this location, the turning movements on North Ruggles Ferry Pike

(West Side) and the turning movements on North Ruggles Ferry Pike (East Side) would require creative traffic signal phasing and timing.

A final note and recommendation for the Andrew Johnson Highway at North Ruggles Ferry Pike (West Side) intersection is the existing north side median nose. For eastbound left-turns from North Ruggles Ferry Pike (West Side) towards the north onto Andrew Johnson Highway, an extra lane is provided in the median that allows for temporary refuge and space to allow for vehicle acceleration to merge into the traffic stream. However, the existing median nose is extremely prohibitive to allowing this turn. The median nose is blunt and does not facilitate left-turns onto the highway and reduces the potential usefulness of the extra lane in the median. It is recommended that this median nose be modified to help facilitate eastbound left turns from North Ruggles Ferry Pike (West Side).



Median of Andrew Johnson Highway at North Ruggles Ferry Pike (West Side)

A summary of the recommendations at this intersection is shown in Figure 9b.

TABLE 9a
2021 SIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS -
ANDREW JOHNSON HIGHWAY AT NORTH RUGGLES FERRY PIKE (WEST SIDE)
EXISTING TRAFFIC CONDITIONS (+20%)

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Andrew Johnson Highway at North Ruggles Ferry Pike (West Side)	Signalized	Eastbound	C	22.4		C	20.9	
		Westbound	A	0.0		B	18.9	
		Northbound	A	2.7		A	3.8	
		Southbound	A	4.0		A	3.2	
		Summary	A	4.5	0.550	A	4.3	0.530

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for signalized intersections
Optimized Cycle Length = 55 Seconds
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio

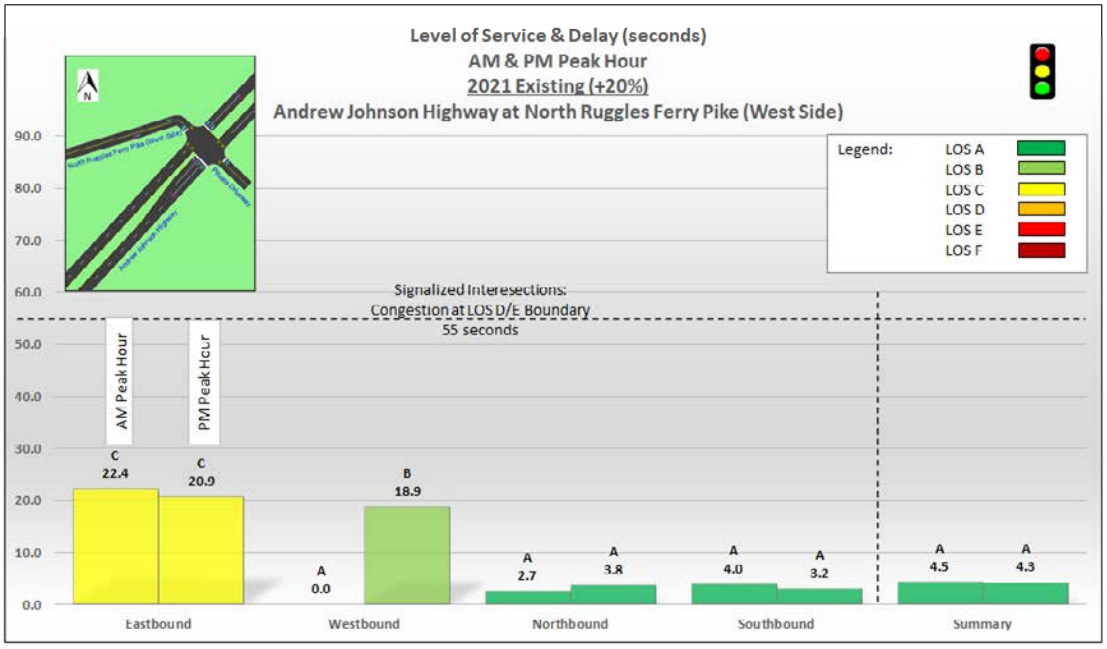
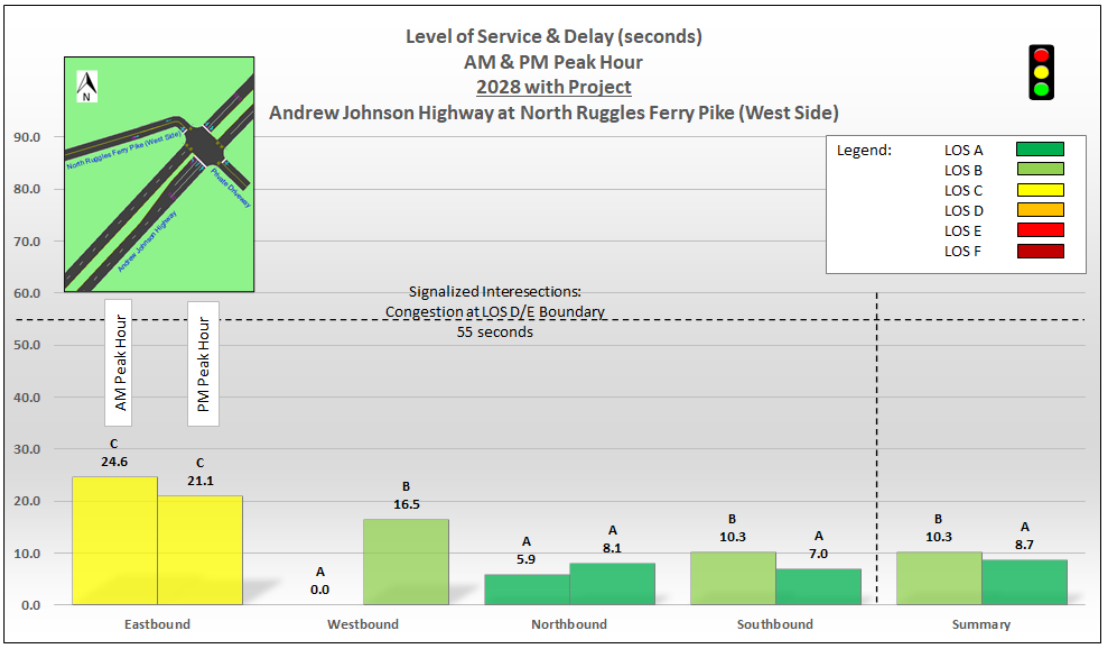


TABLE 9b
2028 SIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS -
ANDREW JOHNSON HIGHWAY AT NORTH RUGGLES FERRY PIKE (WEST SIDE)
OPENING YEAR (2028 WITH PROJECT)

INTERSECTION	TRAFFIC CONTROL	APPROACH/ MOVEMENT	AM PEAK			PM PEAK		
			LOS [a]	DELAY [b] (seconds)	v/c [c]	LOS [a]	DELAY [b] (seconds)	v/c [c]
Andrew Johnson Highway at North Ruggles Ferry Pike (West Side)	Signalized	Eastbound	C	24.6		C	21.1	
		Westbound	A	0.0		B	16.5	
		Northbound	A	5.9		A	8.1	
		Southbound	B	10.3		A	7.0	
		Summary	B	10.3	0.740	A	8.7	0.660

Note: All analyses were calculated in Synchro 8 software and reported with HCM 2000 methodology for signalized intersections
Optimized Cycle Length = 60 Seconds
[a] Level of Service
[b] Average Delay (sec/vehicle)
[c] Volume-to-Capacity Ratio



AJAX ENGINEERING
11812 Black Road
Knoxville, TN 37932
Phone: (865) 556-0042
Email: ajaxengineering@gmail.com

NOT TO SCALE

NORTH

FIGURE 9b

Innsbruck Farms

Summary of Recommended External Road Improvements - Andrew Johnson Highway at North Ruggles Ferry Pike

North Ruggles Ferry Pike at Blake Lane / Road "Q": The intersection of North Ruggles Ferry Pike at Blake Lane / Road "Q" was calculated to operate very well with respect to level of service in the projected conditions in 2028.

3a) A separate exiting left-turn lane or right-turn lane on Blake Lane/Road "Q" at North Ruggles Ferry Pike is not required based on the projected 2028 traffic volumes.

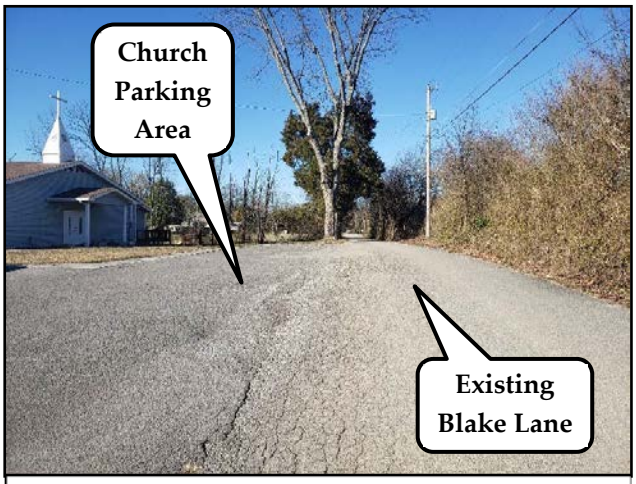
3b) Separate eastbound or westbound lanes on North Ruggles Ferry Pike for entering traffic into the subdivision at Blake Lane/Road "Q" are not warranted.

3c) It is recommended that a Stop Sign (R1-1) and a 24" white stop bar be applied to the pavement of the Blake Lane/Road "Q" approach at North Ruggles Ferry Pike. The stop bar should be applied at a minimum of 4 feet away from the edge of North Ruggles Ferry Pike and should be placed at the desired stopping point that provides the maximum sight distance. An existing Stop Sign (R1-1) currently exists on this north approach but will need to be relocated to widen Blake Lane/Road "Q".

3d) Intersection sight distance at Blake Lane/Road "Q" must not be impacted by future landscaping or signage. Based on a posted speed limit of 40-mph on North Ruggles Ferry Pike, the required intersection sight distance (ISD) is 400 feet looking in each direction at the intersection of North Ruggles Ferry Pike at Blake Lane/Road "Q". Based on an existing 4% grade on North Ruggles Ferry Pike at Blake Lane/Road "Q" and a posted speed limit of 40-mph, the SSD is calculated to be 285 feet for eastbound and 325 feet for westbound vehicles. There is an existing hedgerow on the eastern side of Blake Lane/Road "Q" at North Ruggles Ferry Pike. This hedgerow could interfere with sight distance looking towards the east. This hedgerow will need to be maintained regularly. A licensed land surveyor must verify the available sight distance at this proposed subdivision entrance.

3e) A passing zone for both directions is currently delineated on North Ruggles Ferry Pike's centerline at this proposed entrance location. Knox County Engineering should determine whether this location should maintain this passing zone once the development is constructed with the new entrances.

3f) There is a small church located on the northwestern corner of this intersection. The parking lot for this church abuts Blake Lane. The widening of Blake Lane will require consideration of the pavement interface between the lane and the parking area of the church. Pavement striping may be necessary to delineate the roadway from the parking area.



Blake Lane at Ruggles Ferry Baptist Church

4 **North Ruggles Ferry Pike at Road "A"**: The intersection of North Ruggles Ferry Pike at Road "A" was calculated to operate very well with respect to level of service in the projected conditions in 2028.

4a) A separate exiting left-turn lane or right-turn lane on Road "A" at North Ruggles Ferry Pike is not required based on the projected 2028 traffic volumes.

4b) Separate eastbound or westbound lanes on North Ruggles Ferry Pike for entering traffic into the subdivision at Road "A" are not warranted.

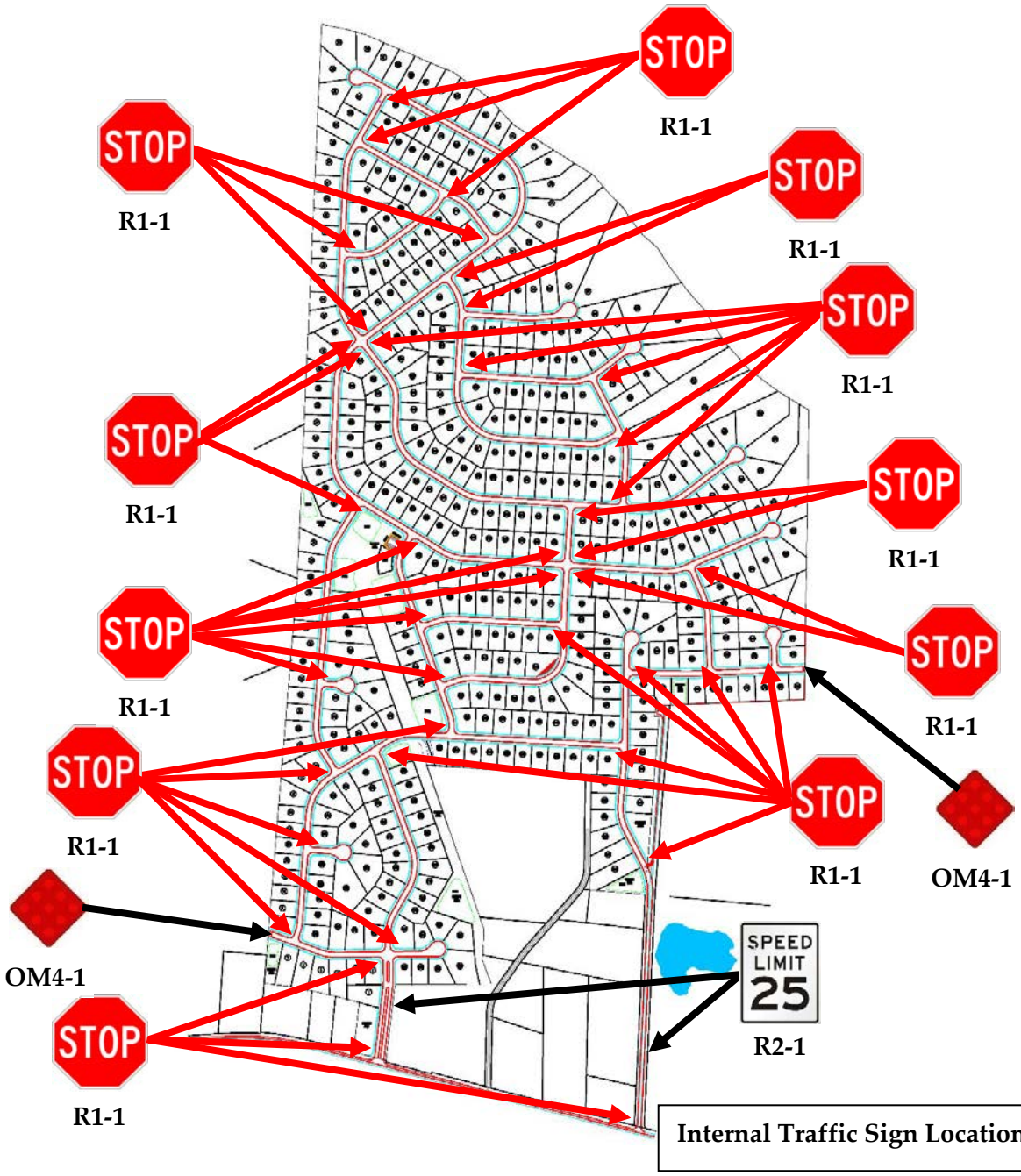
4c) It is recommended that a Stop Sign (R1-1) and a 24" white stop bar be applied to the pavement of the Road "A" approach at North Ruggles Ferry Pike. The stop bar should be applied at a minimum of 4 feet away from the edge of North Ruggles Ferry Pike and should be placed at the desired stopping point that provides the maximum sight distance.

4d) Intersection sight distance at Road "A" must not be impacted by future landscaping or signage. Based on a posted speed limit of 40-mph on North Ruggles Ferry Pike, the required intersection sight distance (ISD) is 400 feet looking in each direction at the intersection of North Ruggles Ferry Pike at and Road "A". Based on an existing 4% grade on North Ruggles Ferry Pike at Road "A" and a posted speed limit of 40-mph, the SSD is calculated to be 325 feet for eastbound and 285 feet for westbound vehicles. There is an existing utility pole on the eastern side of the proposed location of Road "A" at North Ruggles Ferry Pike. This pole could interfere with sight distance looking towards the east. This pole may be removed or relocated to construct Road "A". A licensed land surveyor must verify the available sight distance at this proposed subdivision entrance.

4e) A passing zone for eastbound traffic is currently delineated on North Ruggles Ferry Pike's centerline at this proposed entrance location. Knox County Engineering should determine whether this location should maintain this passing zone once the development is constructed.

5 **Innsbruck Farms Internal Roads:** The current concept plan shows twenty-one new roads being constructed within the development, as shown in Figure 3.

5a) It is recommended that 25-mph Speed Limit Signs (R2-1) be posted near the front of both new streets, Road "A" and Blake Lane/Road "Q", off North Ruggles Ferry Pike. End of roadway signage (OM4-1) should be installed at the western end of Road "B" and the eastern end of Road "R". Stop Signs (R1-1) with 24" white stop bars and other traffic signage should be installed at the locations, as shown below:



5b) Sight distance at the new internal intersections in the development must not be impacted by new signage or future landscaping. With a speed limit of 25-mph in the development, the intersection sight distance requirement is 250 feet. The stopping sight distance required is 155 feet for a level road grade. The road layout designer should ensure that sight distance lengths are met.

5c) All drainage grates and covers for the residential development need to be pedestrian and bicycle safe.

5d) Sidewalks are not proposed for this development. If this changes, they should have appropriate ADA-compliant curbed ramps at intersection corners, and the sidewalks are recommended to be 5 feet minimum in width.

5e) Traffic calming measures might be needed for this development. Several roads within the development have long and straight road segments. The possible need for traffic calming measures inside the development should be coordinated with Knox County Engineering and Public Works during the detailed design phase.

5f) It is a long-standing practice by Knox County that residential subdivisions provide secondary outlets when developments exceed 150 lots. Providing two entrances will spread the load of entering and exiting vehicles. The two entrances, Road "A" and Blake Lane/Road "Q" will be spaced approximately 1,300 feet apart and are not expected to interfere with traffic operations at one another. The Knox County requirement for intersection spacing on a collector road is 300 feet. The spacing between Road "A" and Burris Road is 565 feet. The spacing between Blake Lane/Road "Q" and Burris Road is 735 feet.

5g) All road grade and intersection elements internally and externally should be designed to AASHTO, TDOT, and Knox County specifications and guidelines to ensure proper operation.

3-SB-21-C
Revised: 2/26/2021

APPENDIX A

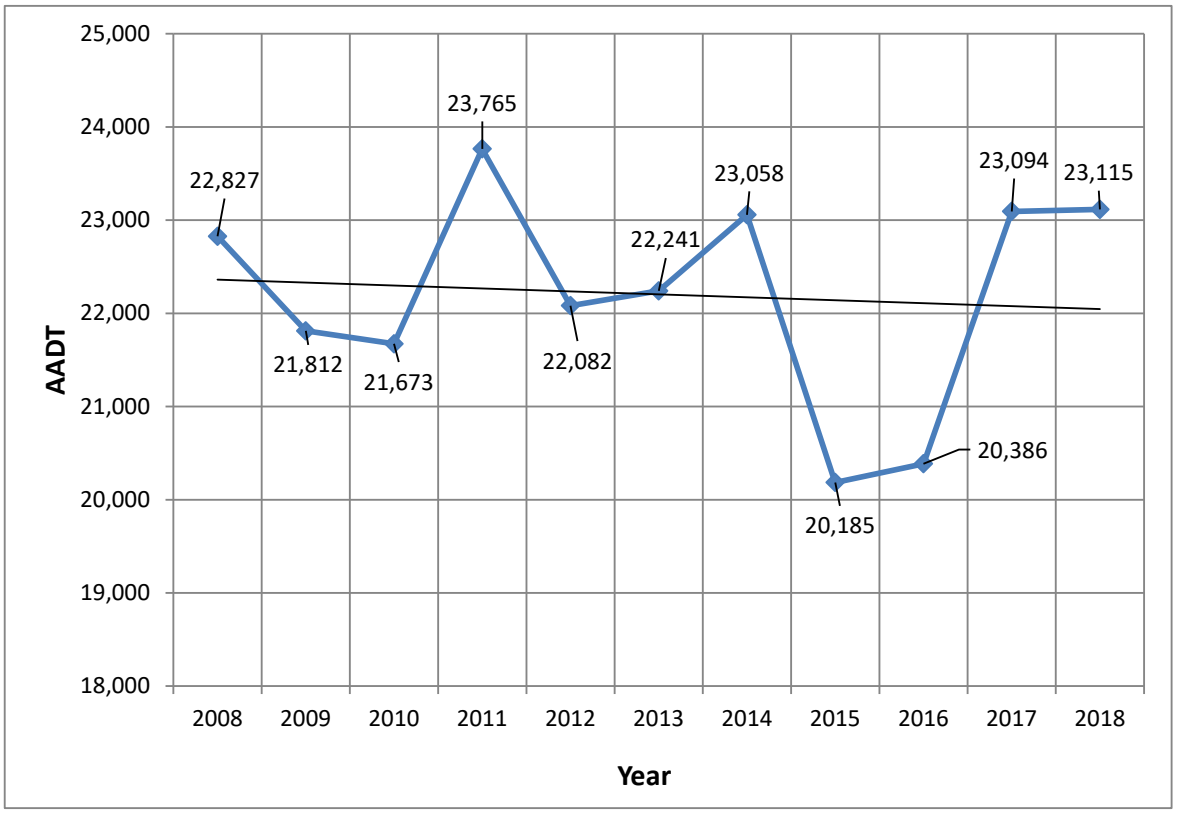
HISTORICAL TRAFFIC COUNT DATA

Historical Traffic Counts

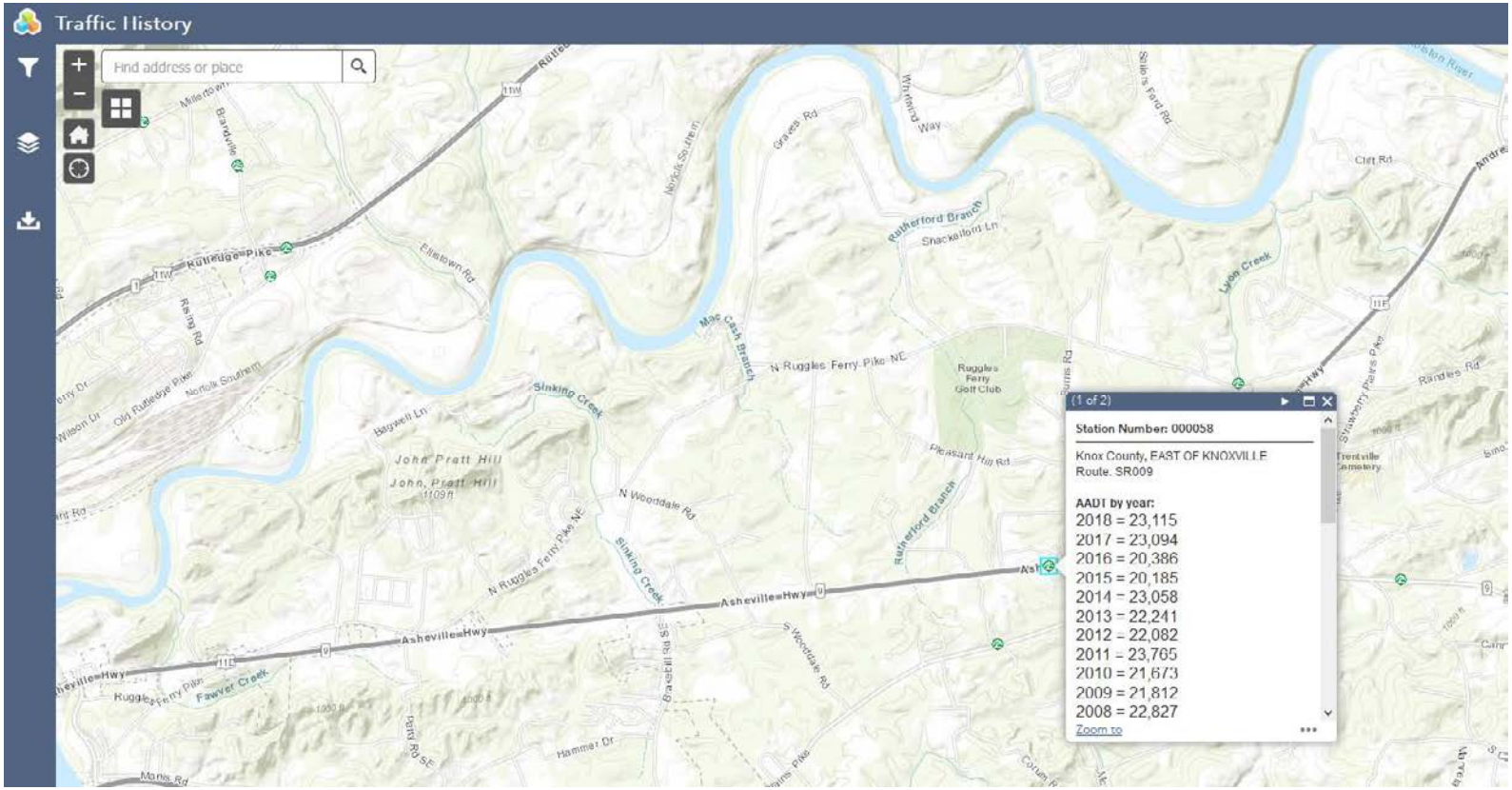
Organization: TDOT
Station ID #: 000058
Location: SR 9, Asheville Highway (west of Meadow Trace Way)

YEAR	AADT
2008	22,827
2009	21,812
2010	21,673
2011	23,765
2012	22,082
2013	22,241
2014	23,058
2015	20,185
2016	20,386
2017	23,094
2018	23,115

Trendline



2008 - 2018 Growth Rate = 1.3%
Average Annual Growth Rate = 0.1%

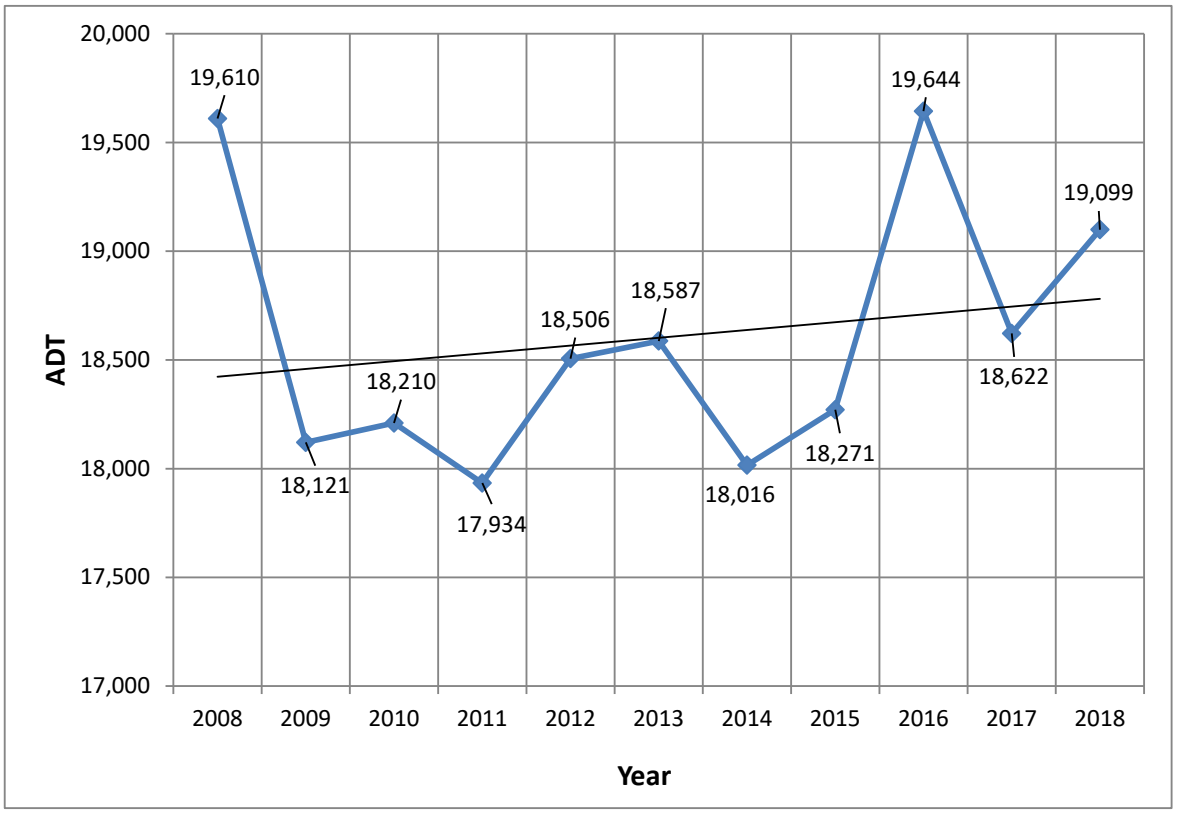

Traffic History
Find address or place
(1 of 2)
Station Number: 000058
Knox County, EAST OF KNOXVILLE
Route: SR009
AADT by year:
2018 = 23,115
2017 = 23,094
2016 = 20,386
2015 = 20,185
2014 = 23,058
2013 = 22,241
2012 = 22,082
2011 = 23,765
2010 = 21,673
2009 = 21,812
2008 = 22,827
Zoom to
Asheville Hwy
Rutledge Pike
Sinking Creek
Rutherford Branch
Lyon Creek
Mac Cash Branch
N Ruggles Ferry Pike NE
Ruggles Ferry Golf Club
John Pratt Hill
Fawver Creek
Ellistown Rd
Graves Rd
Shackelford Ln
Pleasant Hill Rd
N Woodale Rd
S Woodale Rd
Hammer Dr
Randles Rd
Clift Rd
Norfolk Southern
Old Rutledge Pike
Rising Rd
Wilson Dr
Bagwell Ln
Whirlwind Way
Sellers Ford Rd
Strawberry Plains Pike
Trentville Cemetery

Historical Traffic Counts

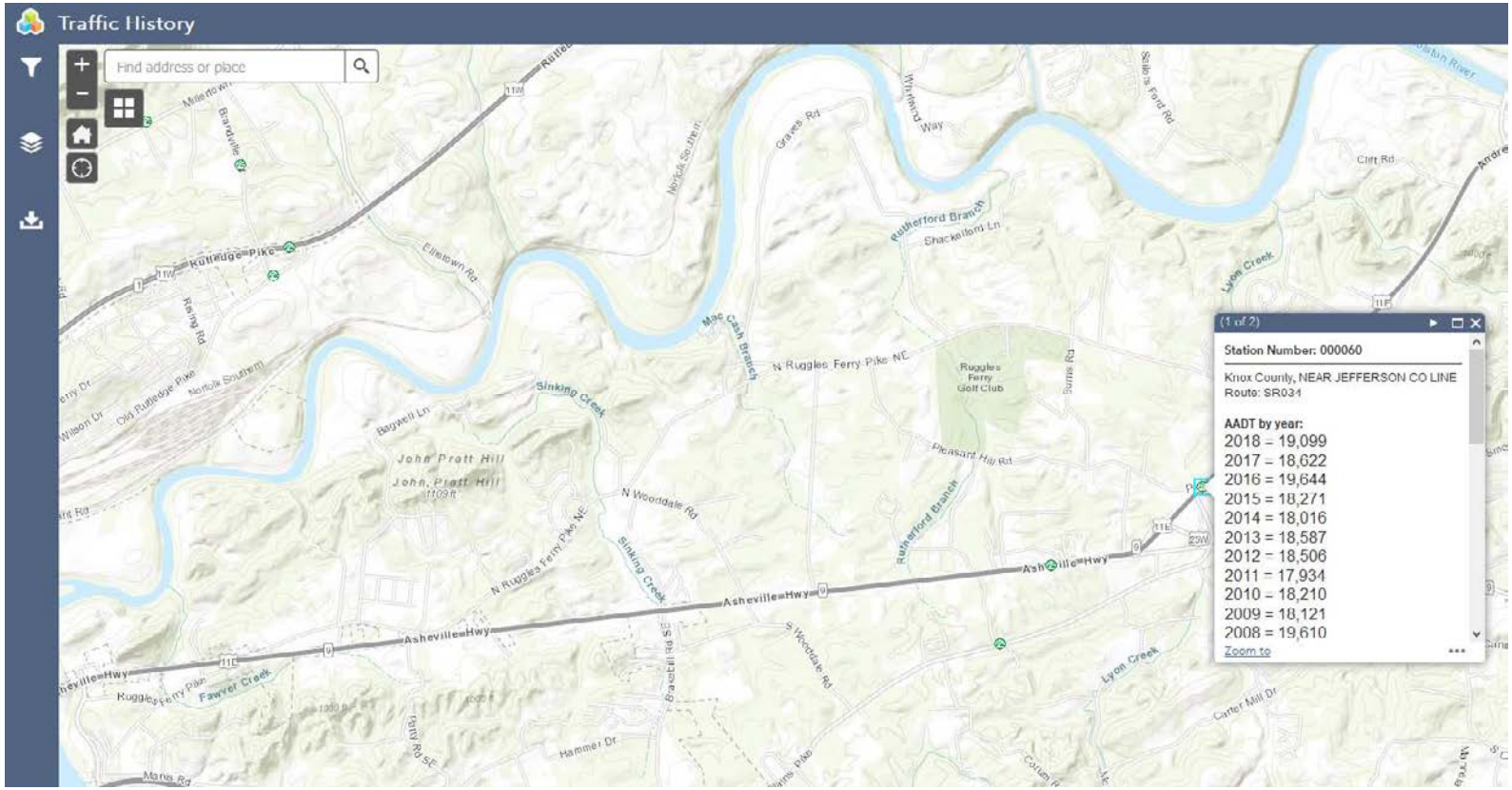
Organization: TDOT
Station ID #: 000060
Location: SR 34 (at Pleasant Hill Road)

YEAR	ADT
2008	19,610
2009	18,121
2010	18,210
2011	17,934
2012	18,506
2013	18,587
2014	18,016
2015	18,271
2016	19,644
2017	18,622
2018	19,099

Trendline



2008 - 2018 Growth Rate = -2.6%
Average Annual Growth Rate = -0.3%

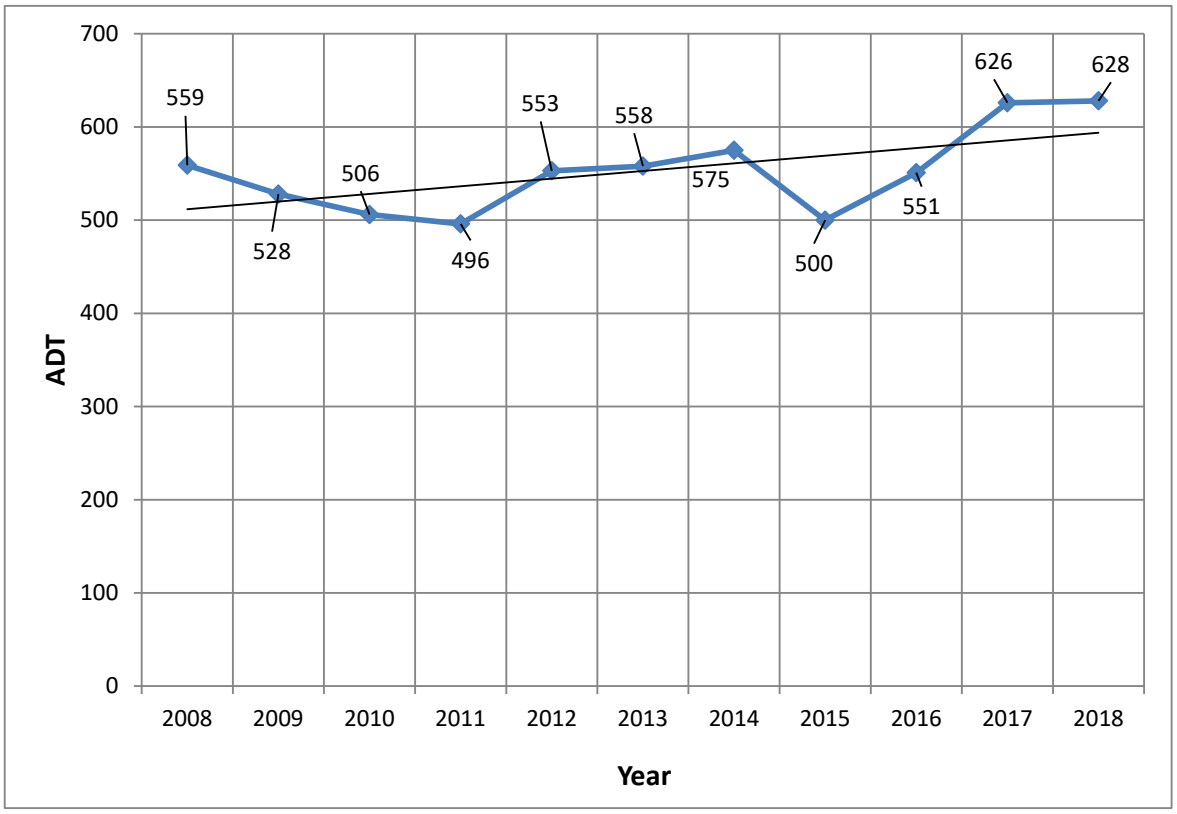

Traffic History
Find address or place
(1 of 2)
Station Number: 000060
Knox County, NEAR JEFFERSON CO LINE
Route: SR034
AADT by year:
2018 = 19,099
2017 = 18,622
2016 = 19,644
2015 = 18,271
2014 = 18,016
2013 = 18,587
2012 = 18,506
2011 = 17,934
2010 = 18,210
2009 = 18,121
2008 = 19,610
Zoom to
Asheville Hwy
Rutledge Pike
Sinking Creek
Rutherford Branch
Lyon Creek
Fawver Creek
John Pratt Hill
N Ruggles Ferry Pike NE
Ruggles Ferry Golf Club
Pleasant Hill Rd
N Wooddale Rd
S Wooddale Rd
Hammer Dr
Carter Mill Dr
Clift Rd
Graves Rd
Shackelford Ln
Norfolk Southern
Bagwell Ln
Ellistown Rd
Rising Rd
Old Rutledge Pike
Wilson Dr
Manis Rd
Brakebill Rd SE
Patty Rd SE
Mac Cash Branch
Whirlwind Way
Sailors Ford Rd
Sims Rd
Millertown
Brandville
Ruggles Ferry Pike

Historical Traffic Counts

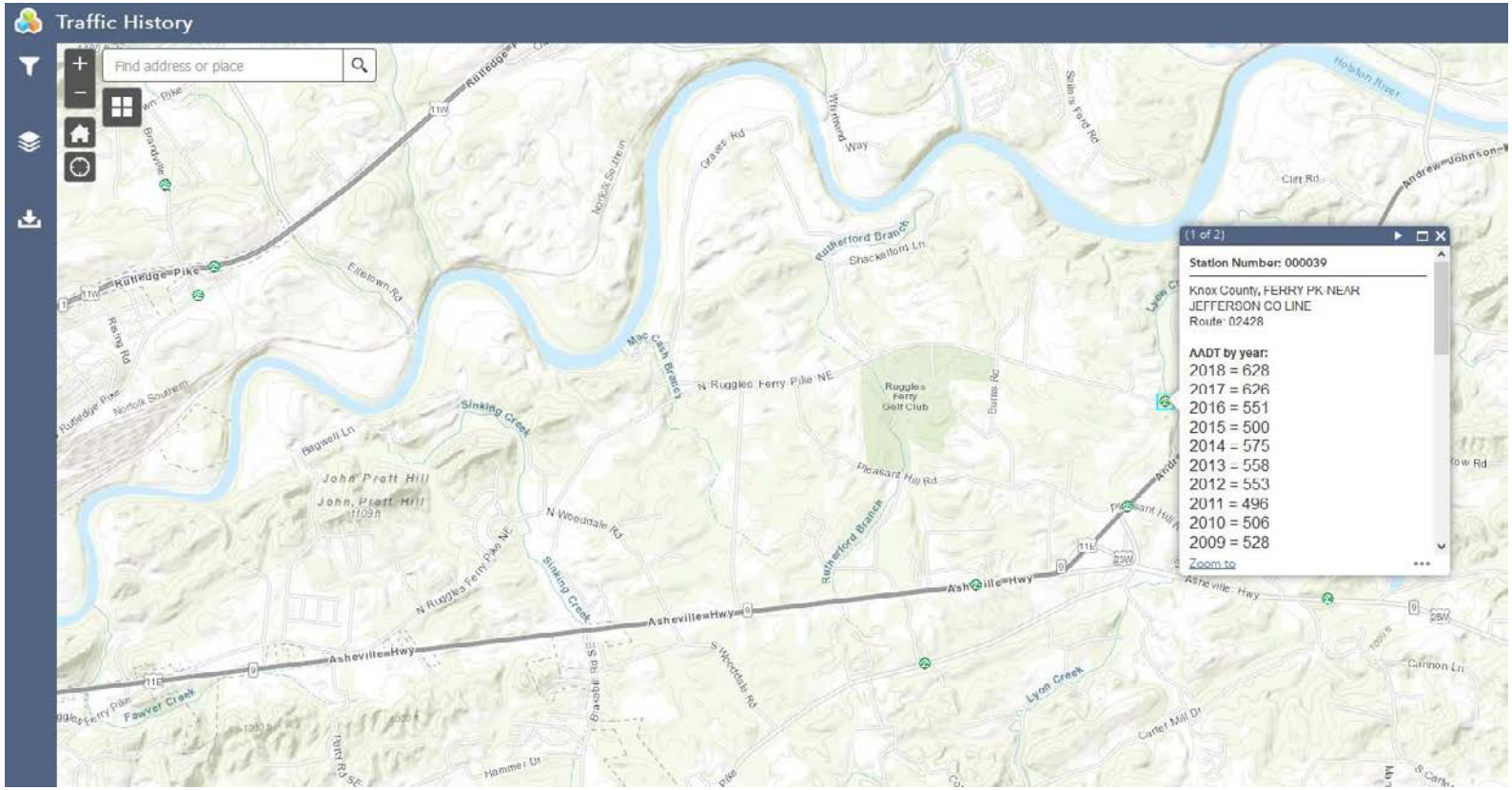
Organization: TDOT
Station ID #: 000039
Location: North Ruggles Ferry Pike (east of Rugby Lane)

YEAR	ADT
2008	559
2009	528
2010	506
2011	496
2012	553
2013	558
2014	575
2015	500
2016	551
2017	626
2018	628

Trendline



2008 - 2018 Growth Rate = 12.3%
Average Annual Growth Rate = 1.2%

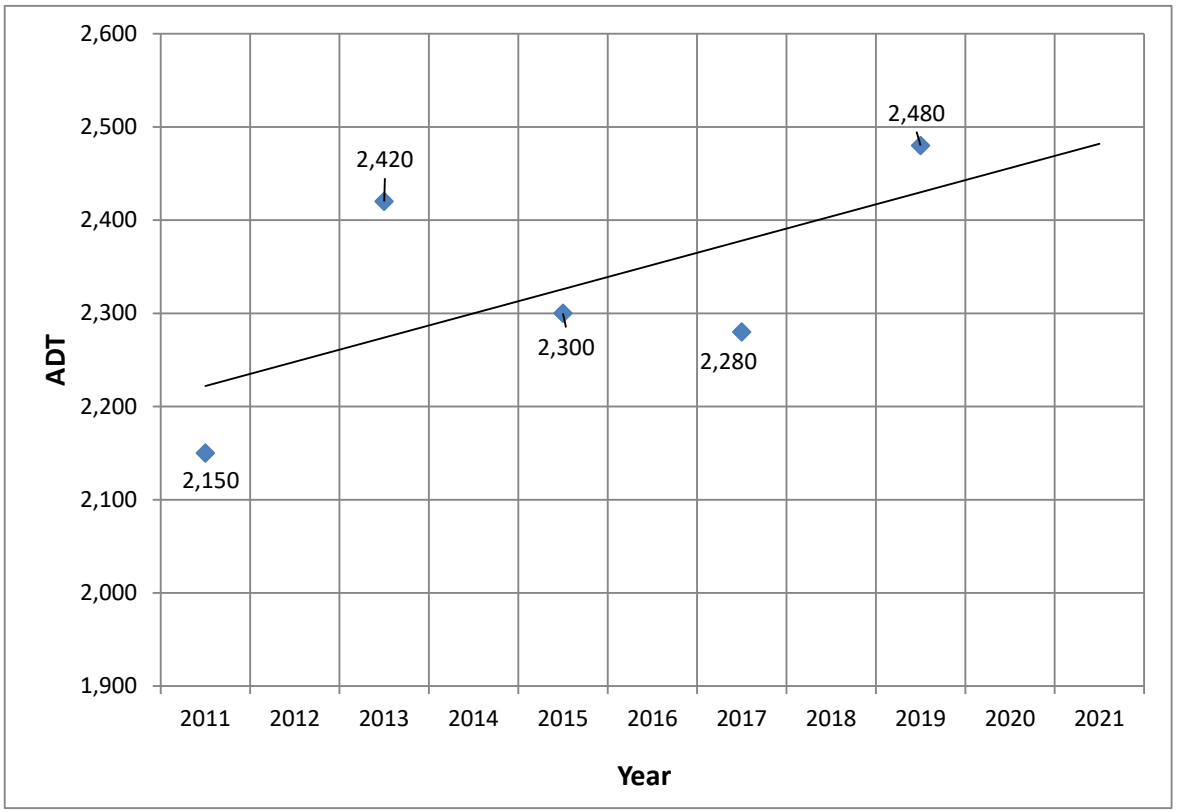

Traffic History
Find address or place
(1 of 2)
Station Number: 000039
Knox County, FERRY PK NEAR
JEFFERSON CO LINE
Route: 02428
AADT by year:
2018 = 628
2017 = 626
2016 = 551
2015 = 500
2014 = 575
2013 = 558
2012 = 553
2011 = 496
2010 = 506
2009 = 528
Zoom to
Rutledge Pike
Asheville Hwy
Sinking Creek
Rutherford Branch
Mac Cash Branch
Lyon Creek
Fawver Creek
John Pratt Hill
Ruggles Ferry Golf Club
N Ruggles Ferry Pike NE
N Woodale Rd
Pleasant Hill Rd
Shackelford Ln
Graves Rd
Ellistown Rd
Norfolk Southern
Bagwell Ln
Hammer Dr
Carter Mill Dr
Cannon Ln
Clift Rd
Holston River
Andrew Johnson

Historical Traffic Counts

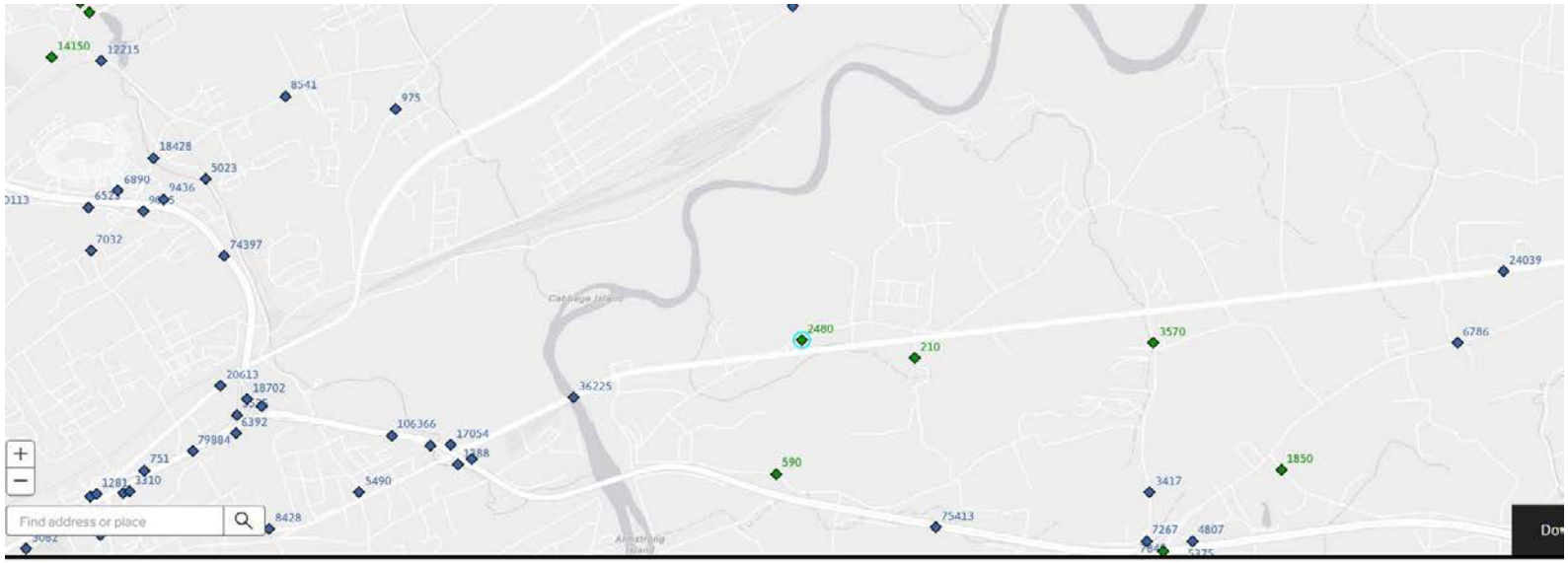
Organization: Knox TPO
Station ID #: 093M038
Location: North Ruggles Ferry Pike (north of Asheville Highway)

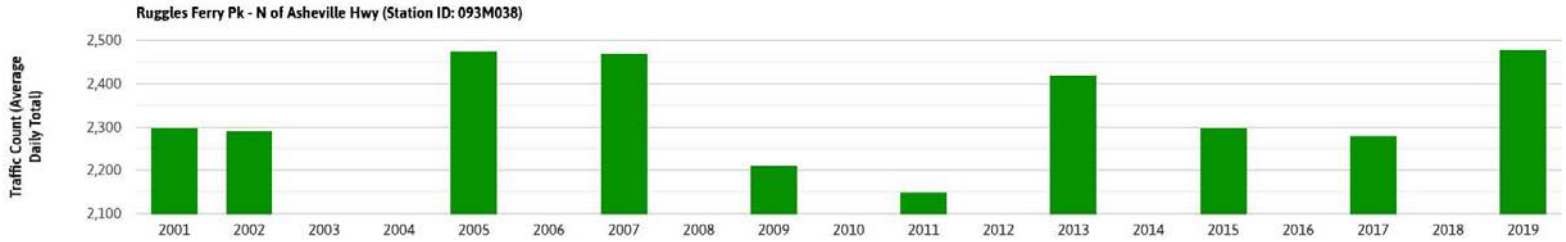
YEAR	ADT
2011	2,150
2012	
2013	2,420
2014	
2015	2,300
2016	
2017	2,280
2018	
2019	2,480
2020	
2021	

Trendline



2011 - 2019 Growth Rate = 15.3%
Average Annual Growth Rate = 1.8%

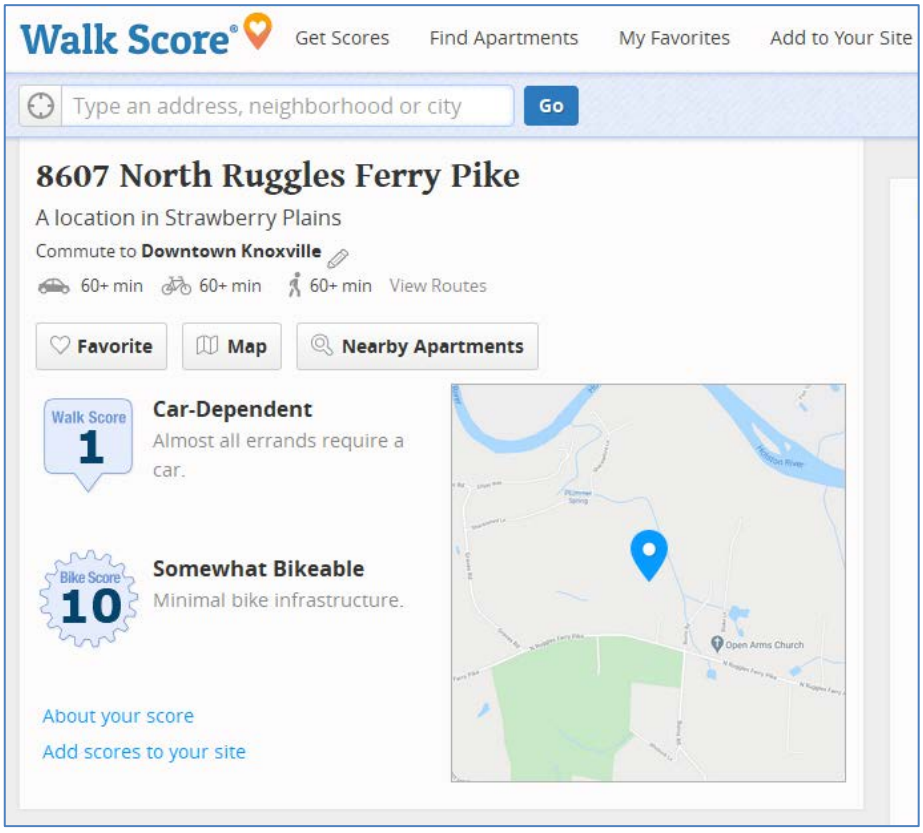

14150
12215
8541
975
18428
5023
6890
9436
7032
74397
24039
2480
210
3570
6786
20613
18702
36225
6392
106366
17054
79884
751
590
1850
1281
3310
5490
3417
8428
75413
7267
4807
Find address or place


Ruggles Ferry Pk - N of Asheville Hwy (Station ID: 093M038)
Traffic Count (Average Daily Total)
2,500
2,400
2,300
2,200
2,100
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019

APPENDIX B

WALK SCORE

WALKSCORE
(from walkscore.com)



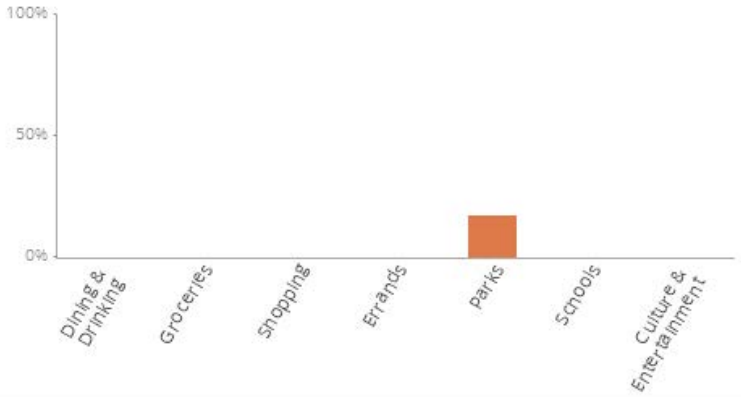
Scores for 8607 North Ruggles Ferry Pike

Walk Score 1 | Bike Score 10

Walk Score | **Transit Score** | **Bike Score**

Score Details | **What is Walk Score**

The Walk Score for 8607 North Ruggles Ferry Pike is based on the following categories.



Scores for 8607 North Ruggles Ferry Pike

Walk Score 1 | Bike Score 10

Walk Score | **Transit Score** | **Bike Score**

Transit Score measures how well a location is served by public transit based on the distance and type of nearby transit lines.

90–100	**Rider's Paradise** World-class public transportation
70–89	**Excellent Transit** Transit is convenient for most trips
50–69	**Good Transit** Many nearby public transportation options
25–49	**Some Transit** A few nearby public transportation options
0–24	**Minimal Transit** It is possible to get on a bus

Scores for 8607 North Ruggles Ferry Pike

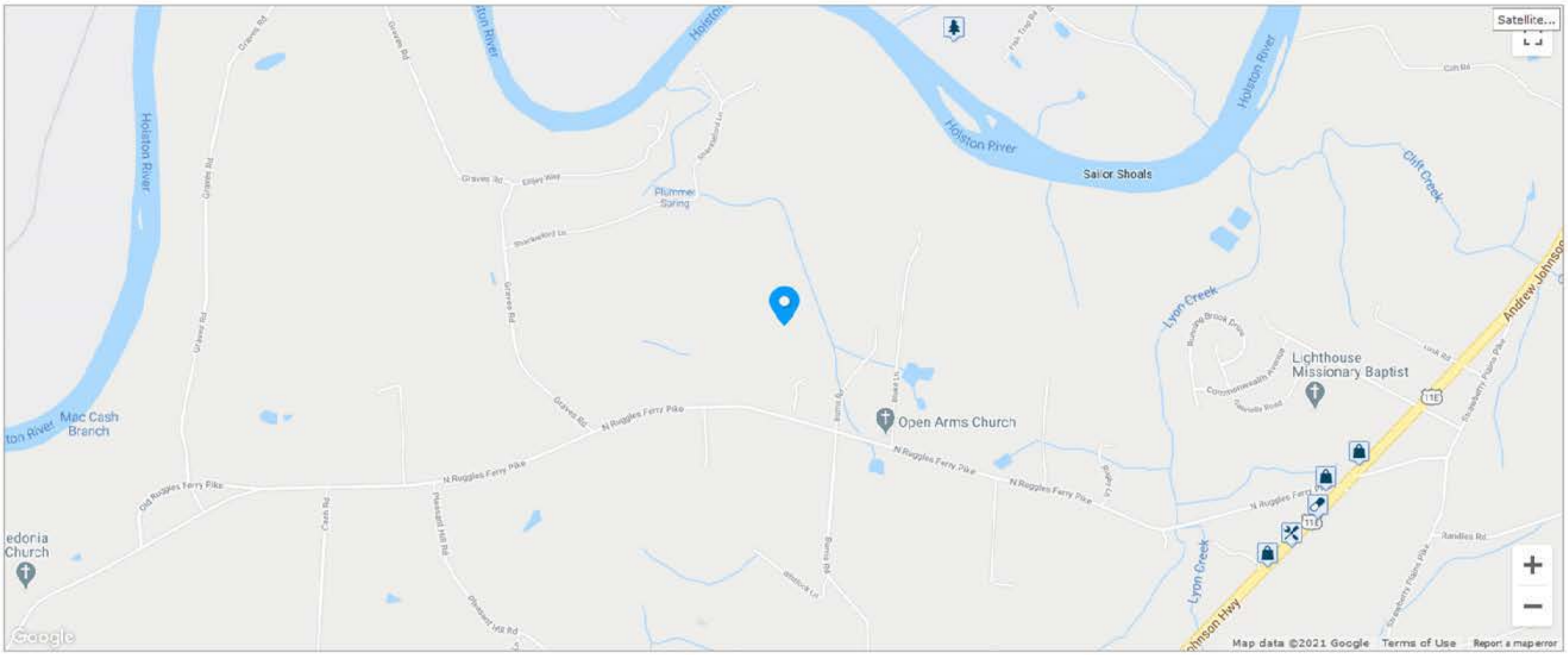
Walk Score	Transit Score	Bike Score

Bike Score measures whether an area is good for biking based on bike lanes and trails, hills, road connectivity, and destinations.

90–100	**Biker's Paradise** Daily errands can be accomplished on a bike
70–89	**Very Bikeable** Biking is convenient for most trips
50–69	**Bikeable** Some bike infrastructure
0–49	**Somewhat Bikeable** Minimal bike infrastructure

What's Nearby

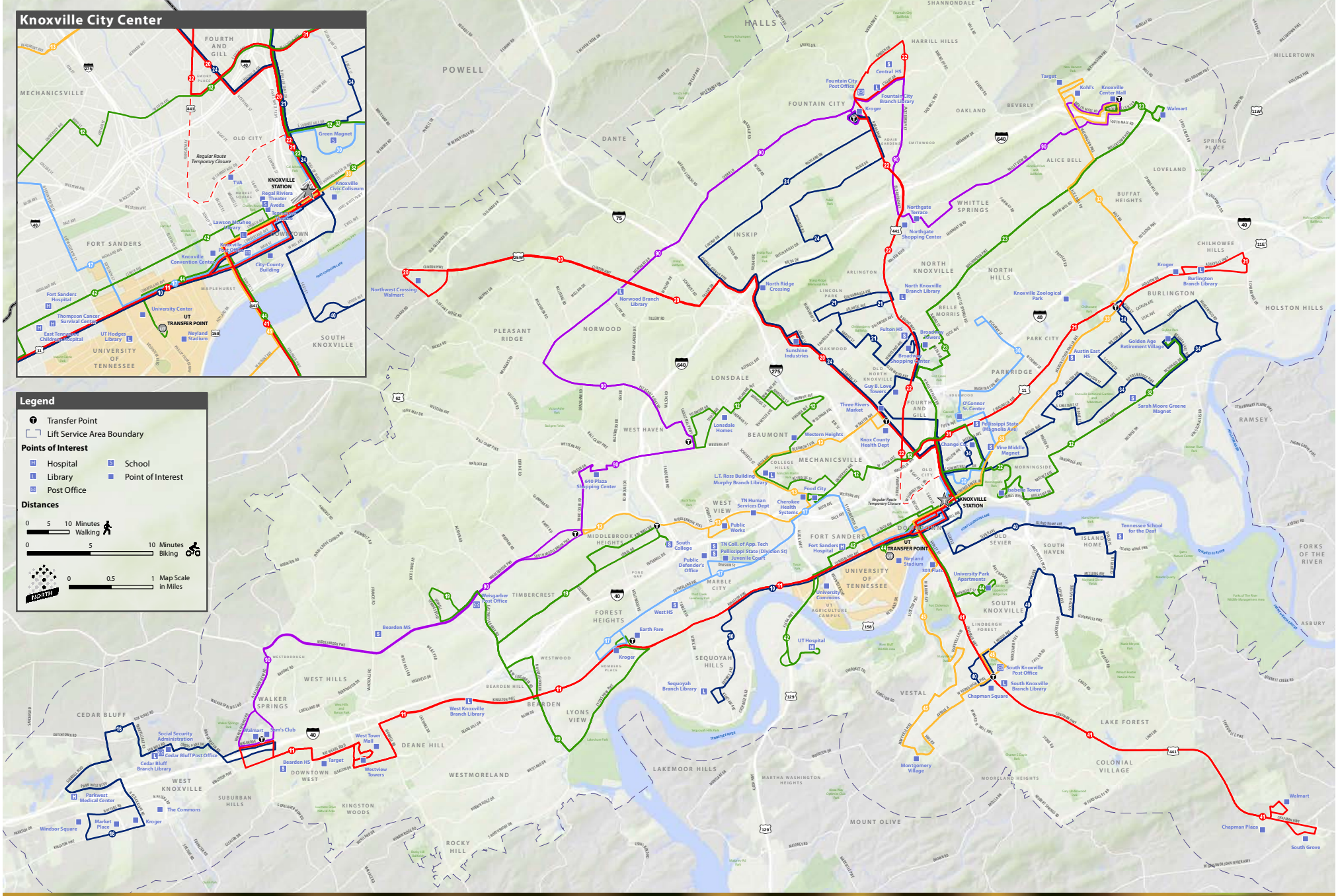
Restaurants:	Pizza Plus	1.3mi
Coffee:	The Coffee Bean and Tea Leaf	7.4mi
Bars:	Oak Lounge	3.1mi
Groceries:	Town and Country Market & G...	2.5mi
Parks:	Mascot Park	.7mi
Schools:	Carter High School	1.9mi
Shopping:	Cedar Bend Kennels	1.2mi
Entertainment:	Honorary Consulate Of The R...	6.9mi
Errands:	US Post Office	1.2mi
Search Nearby:		



Something missing? Add a place

APPENDIX C

KNOXVILLE AREA TRANSIT MAP AND INFORMATION



FARE INFORMATION

With a base fare of $1.50, KAT offers a variety of passes. Please note that only the fares marked with an asterisk can be purchased when boarding the bus. Others are available at KAT's Customer Service Counter at Knoxville Station (301 Church Ave.) or by mail via katbus.com.

FARE TYPE	REGULAR FARE	REDUCED FARE
One-Ride Pass*	$1.50	$0.75
1 Day Pass*	$4.00	$2.00
7 Day Pass	$15.00	$7.50
30 Day Pass	$50.00	$25.00
20 Ride Pass	$25.00	$12.50
Transfer*	$0.50	$0.25

REDUCED FARE INFORMATION

A reduced fare is available to those who qualify. Qualifying individuals include seniors age 65 or over, Medicare card holders, students under the age of 18, and persons with disabilities. Proper identification (Medicare card or a valid KAT I.D. card) is required before boarding. For more information on how to obtain a discounted-fare I.D. visit katbus.com/fares or call 637-3000.

BUS STOPS ONLY!

KAT buses stop ONLY at locations designated by bus stop signs. Generally, bus stops are located at least every ¼ mile along the route.

KAT HOLIDAYS

KAT buses do not run on the following holidays:

- New Year's Day
- Independence Day
- Thanksgiving
- Christmas

Please note that KAT's Knoxville Station Customer Service counter is also closed during those days.

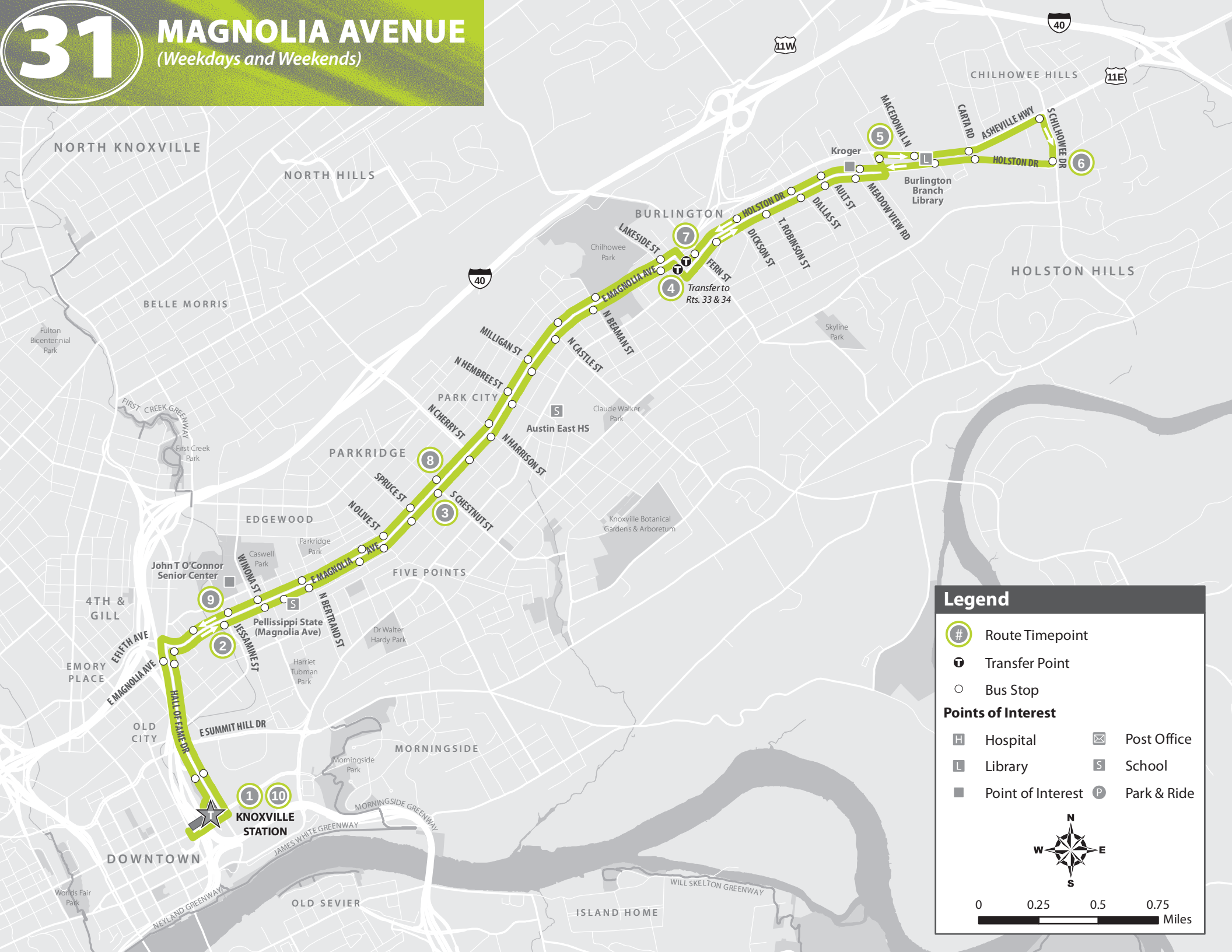
KAT buses run on a Saturday schedule on the following holidays:

- Martin Luther King, Jr. Day
- Memorial Day
- Labor Day
- Day after Thanksgiving
- Christmas Eve

KAT's administrative offices are closed on all holidays listed above.

31 MAGNOLIA AVENUE

(Weekdays and Weekends)



Legend

- Route Timepoint
- Transfer Point
- Bus Stop

Points of Interest

- Hospital
- Library
- Point of Interest
- Post Office
- School
- Park & Ride

N W E S

0 0.25 0.5 0.75 Miles

31 MAGNOLIA AVENUE

(Weekdays and Weekends)

SERVES:

- Burlington Branch Library
- Chilhowee Park
- Holston Drive
- Knoxville Station/Downtown
- Kroger
- Pellissippi State, Magnolia Ave. Campus

kat KNOXVILLE AREA TRANSIT

Information Updated: January 6, 2020

	Going away from Downtown						Going toward Downtown					
	Transfer to:			Rts. 33 & 34				Rts. 33 & 34				
	Knoxville Station—Platform F	Magnolia at Jessamine	Magnolia at Chestnut	Kirkwood St. Superstop (Arrives)	Kirkwood St. Superstop (Leaves)	Burns Rd at Asheville Hwy	Chilhowee at Holston	Kirkwood St. Superstop (Arrives)	Kirkwood St. Superstop (Leaves)	Magnolia at Chestnut	Magnolia at Jessamine	Knoxville Station
	1	2	3	4		5	6	7		8	9	10
WEEKDAY SCHEDULE												
A.M.	—	—	—	—	—	5:38	5:43	5:51	5:53	5:59	6:04	6:10
						5:53	5:58	6:06	6:08	6:14	6:19	6:25
	—	—	—	—	—	6:08	6:13	6:21	6:23	6:29	6:34	6:40
						6:23	6:28	6:36	6:38	6:44	6:49	6:55
	6:15	6:19	6:25	6:30	6:33	6:38	6:43	6:51	6:53	6:59	7:04	7:10
	6:30	6:34	6:40	6:45	6:48	6:53	6:58	7:06	7:08	7:14	7:19	7:25
	6:45	6:49	6:55	7:00	7:03	7:08	7:13	7:21	7:23	7:29	7:34	7:40
	7:00	7:04	7:10	7:15	7:18	7:23	7:28	7:36	7:38	7:44	7:49	7:55
	7:15	7:19	7:25	7:30	7:33	7:38	7:43	7:51	7:53	7:59	8:04	8:10
	7:30	7:34	7:40	7:45	7:48	7:53	7:58	8:06	8:08	8:14	8:19	8:25
	7:45	7:49	7:55	8:00	8:03	8:08	8:13	8:21	8:23	8:29	8:34	8:40
	8:00	8:04	8:10	8:15	8:18	8:23	8:28	8:36	8:38	8:44	8:49	8:55
	8:15	8:19	8:25	8:30	8:33	8:38	8:43	8:51	8:53	8:59	9:04	9:10
	8:30	8:34	8:40	8:45	8:48	8:53	8:58	9:06	9:08	9:14	9:19	9:25
	8:45	8:49	8:55	9:00	9:03	9:08	9:13	9:21	9:23	9:29	9:34	9:40
	9:00	9:04	9:10	9:15	9:18	9:23	9:28	9:36	9:38	9:44	9:49	9:55
	9:15	9:19	9:25	9:30	9:33	9:38	9:43	9:51	9:53	9:59	10:04	10:10
	9:45	9:49	9:55	10:00	10:03	10:08	10:13	10:21	10:23	10:29	10:34	10:40
	10:15	10:19	10:25	10:30	10:33	10:38	10:43	10:51	10:53	10:59	11:04	11:10
	10:45	10:49	10:55	11:00	11:03	11:08	11:13	11:21	11:23	11:29	11:34	11:40
	11:15	11:19	11:25	11:30	11:33	11:38	11:43	11:51	11:53	11:59	**12:04**	**12:10**
	11:45	11:49	11:55	**12:00**	**12:03**	**12:08**	**12:13**	**12:21**	**12:23**	**12:29**	**12:34**	**12:40**
P.M.	**12:15**	**12:19**	**12:25**	**12:30**	**12:33**	**12:38**	**12:43**	**12:51**	**12:53**	**12:59**	**1:04**	**1:10**
	12:45	**12:49**	**12:55**	**1:00**	**1:03**	**1:08**	**1:13**	**1:21**	**1:23**	**1:29**	**1:34**	**1:40**
	1:15	**1:19**	**1:25**	**1:30**	**1:33**	**1:38**	**1:43**	**1:51**	**1:53**	**1:59**	**2:04**	**2:10**
	1:45	**1:49**	**1:55**	**2:00**	**2:03**	**2:08**	**2:13**	**2:21**	**2:23**	**2:29**	**2:34**	**2:40**
	2:15	**2:19**	**2:25**	**2:30**	**2:33**	**2:38**	**2:43**	**2:51**	**2:53**	**2:59**	**3:04**	**3:10**
	2:45	**2:49**	**2:55**	**3:00**	**3:03**	**3:08**	**3:13**	**3:21**	**3:23**	**3:29**	**3:34**	**3:40**
	3:15	**3:19**	**3:25**	**3:30**	**3:33**	**3:38**	**3:43**	**3:51**	**3:53**	**3:59**	**4:04**	**4:10**
	—	—	—	—	—	**3:53**	**3:58**	**4:06**	**4:08**	**4:14**	**4:19**	**4:25**
	3:45	**3:49**	**3:55**	**4:00**	**4:03**	**4:08**	**4:13**	**4:21**	**4:23**	**4:29**	**4:34**	**4:40**
	4:00	**4:04**	**4:10**	**4:15**	**4:18**	**4:23**	**4:28**	**4:36**	**4:38**	**4:44**	**4:49**	**4:55**
	4:15	**4:19**	**4:25**	**4:30**	**4:33**	**4:38**	**4:43**	**4:51**	**4:53**	**4:59**	**5:04**	**5:10**
	4:30	**4:34**	**4:40**	**4:45**	**4:48**	**4:53**	**4:58**	**5:06**	**5:08**	**5:14**	**5:19**	**5:25**
	4:45	**4:49**	**4:55**	**5:00**	**5:03**	**5:08**	**5:13**	**5:21**	**5:23**	**5:29**	**5:34**	**5:40**
	5:00	**5:04**	**5:10**	**5:15**	**5:18**	**5:23**	**5:28**	**5:36**	**5:38**	**5:44**	**5:49**	**5:55**
	5:15	**5:19**	**5:25**	**5:30**	**5:33**	**5:38**	**5:43**	**5:51**	**5:53**	**5:59**	**6:04**	**6:10**
	5:30	**5:34**	**5:40**	**5:45**	**5:48**	**5:53**	**5:58**	**6:06**	**6:08**	**6:14**	**6:19**	**6:25**
	5:45	**5:49**	**5:55**	**6:00**	**6:03**	**6:08**	**6:13**	**6:21**	**6:23**	**6:29**	**6:34**	**6:40**
	6:00	**6:04**	**6:10**	**6:15**	**6:18**	**6:23**	**6:28**	**6:36**	**6:38**	**6:44**	**6:49**	**6:55**
	6:15	**6:19**	**6:25**	**6:30**	**6:33**	**6:38**	**6:43**	**6:51**	**6:53**	**6:59**	**7:04**	**7:10**
	6:45	**6:49**	**6:55**	**7:00**	**7:03**	**7:08**	**7:13**	**7:21**	**7:23**	**7:29**	**7:34**	**7:40**
	7:15	**7:19**	**7:25**	**7:30**	**7:33**	**7:38**	**7:43**	**7:51**	**7:53**	**7:59**	**8:04**	**8:10**
	7:45	**7:49**	**7:55**	**8:00**	**8:03**	**8:08**	**8:13**	**8:21**	**8:23**	**8:29**	**8:34**	**8:40**
	8:15	**8:19**	**8:25**	**8:30**	**8:33**	**8:38**	**8:43**	**8:51**	**8:53**	**8:59**	**9:04**	**9:10**
	8:45	**8:49**	**8:55**	**9:00**	**9:03**	**9:08**	**9:13**	**9:21**	**9:23**	**9:29**	**9:34**	**9:40**
	9:15	**9:19**	**9:25**	**9:30**	**9:33**	**9:38**	**9:43**	**9:51**	**9:53**	**9:59**	**10:04**	**10:10**
	9:45	**9:49**	**9:55**	**10:00**	**10:03**	**10:08**	**10:13**	**10:21**	**10:23**	**10:29**	**10:34**	*To Garage*
	10:15	**10:19**	**10:25**	**10:30**	**10:33**	**10:38**	**10:43**	**10:51**	**10:53**	**10:59**	**11:04**	**11:10**
	11:15	**11:19**	**11:25**	**11:30**	**11:33**	**11:38**	**11:43**	**11:51**	**11:53**	**11:59**	**12:04**	*To Garage*

Need help reading this schedule?
Need other general information on how to ride?
Click here to Download the General Schedule Information pdf available from katbus.com

31 MAGNOLIA AVENUE

(Weekdays and Weekends)

SERVES:

- Burlington Branch Library
- Chilhowee Park
- Holston Drive
- Knoxville Station/Downtown
- Kroger
- Pellissippi State, Magnolia Ave. Campus

kat KNOXVILLE AREA TRANSIT

Information Updated: January 6, 2020

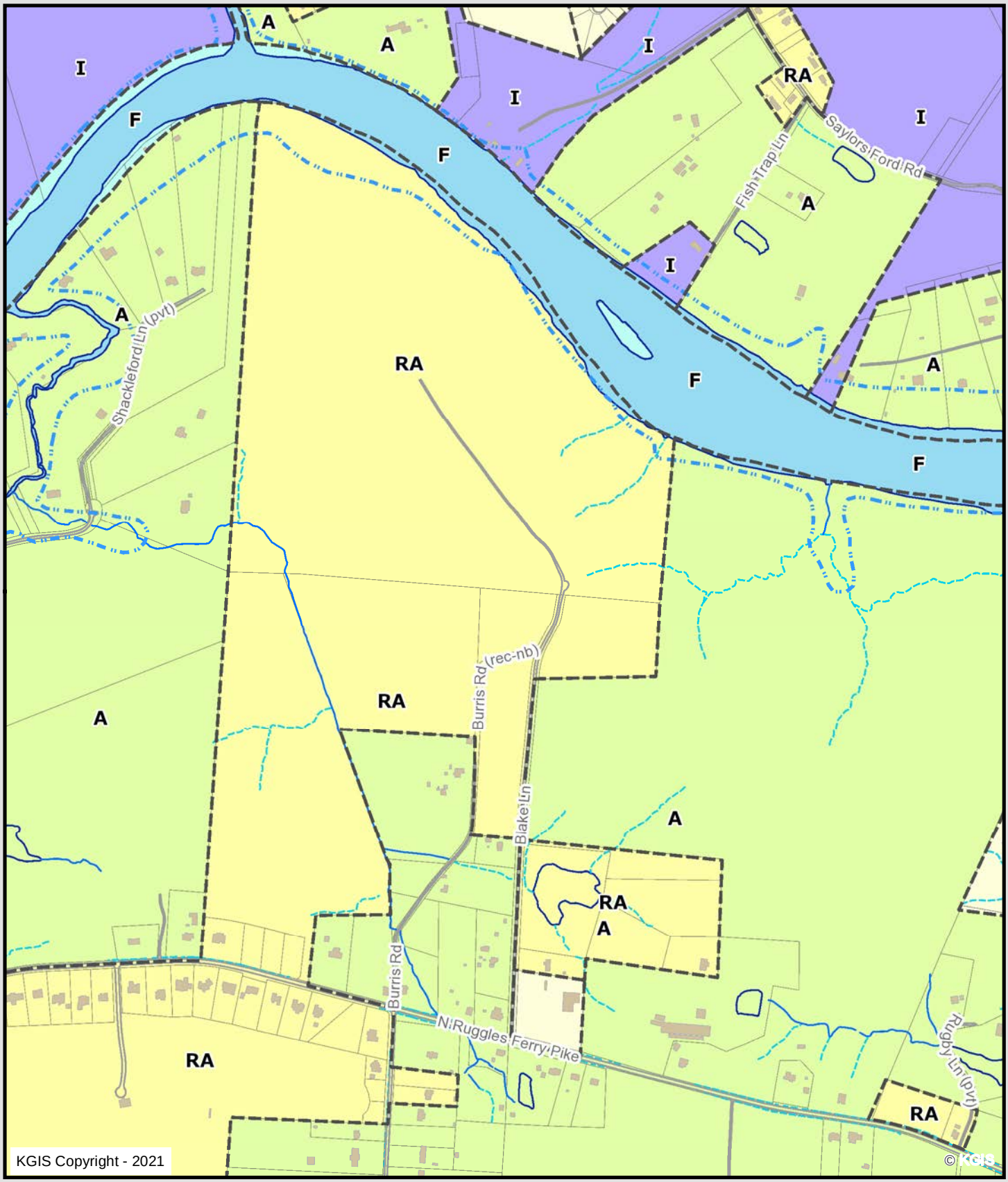
Saturday-Sunday Schedule Route 31: Magnolia

	Going away from Downtown						Going toward Downtown					
	Transfer to:			Rts. 33 & 34				Rts. 33 & 34				
	Knoxville Station—Platform F	Magnolia at Jessamine	Magnolia at Chestnut	Kirkwood St. Superstop (Arrives)	Kirkwood St. Superstop (Leaves)	Burns Rd at Asheville Hwy	Chilhowee at Holston	Kirkwood St. Superstop (Arrives)	Kirkwood St. Superstop (Leaves)	Magnolia at Chestnut	Magnolia at Jessamine	Knoxville Station
	1	2	3	4		5	6	7		8	9	10
SATURDAY SCHEDULE												
A.M.	—	—	—	—	—	6:38	6:43	6:51	6:53	6:59	7:04	7:10
	—	—	—	—	—	7:08	7:13	7:21	7:23	7:29	7:34	7:40
	7:15	7:19	7:25	7:30	7:33	7:38	7:43	7:51	7:53	7:59	8:04	8:10
	7:45	7:49	7:55	8:00	8:03	8:08	8:13	8:21	8:23	8:29	8:34	8:40
	8:15	8:19	8:25	8:30	8:33	8:38	8:43	8:51	8:53	8:59	9:04	9:10
	8:45	8:49	8:55	9:00	9:03	9:08	9:13	9:21	9:23	9:29	9:34	9:40
	9:15	9:19	9:25	9:30	9:33	9:38	9:43	9:51	9:53	9:59	10:04	10:10
	9:45	9:49	9:55	10:00	10:03	10:08	10:13	10:21	10:23	10:29	10:34	10:40
	10:15	10:19	10:25	10:30	10:33	10:38	10:43	10:51	10:53	10:59	11:04	11:10
	10:45	10:49	10:55	11:00	11:03	11:08	11:13	11:21	11:23	11:29	11:34	11:40
	11:15	11:19	11:25	11:30	11:33	11:38	11:43	11:51	11:53	11:59	**12:04**	**12:10**
	11:45	11:49	11:55	**12:00**	**12:03**	**12:08**	**12:13**	**12:21**	**12:23**	**12:29**	**12:34**	**12:40**
P.M.	**12:15**	**12:19**	**12:25**	**12:30**	**12:33**	**12:38**	**12:43**	**12:51**	**12:53**	**12:59**	**1:04**	**1:10**
	12:45	**12:49**	**12:55**	**1:00**	**1:03**	**1:08**	**1:13**	**1:21**	**1:23**	**1:29**	**1:34**	**1:40**
	1:15	**1:19**	**1:25**	**1:30**	**1:33**	**1:38**	**1:43**	**1:51**	**1:53**	**1:59**	**2:04**	**2:10**
	1:45	**1:49**	**1:55**	**2:00**	**2:03**	**2:08**	**2:13**	**2:21**	**2:23**	**2:29**	**2:34**	**2:40**
	2:15	**2:19**	**2:25**	**2:30**	**2:33**	**2:38**	**2:43**	**2:51**	**2:53**	**2:59**	**3:04**	**3:10**
	2:45	**2:49**	**2:55**	**3:00**	**3:03**	**3:08**	**3:13**	**3:21**	**3:23**	**3:29**	**3:34**	**3:40**
	3:15	**3:19**	**3:25**	**3:30**	**3:33**	**3:38**	**3:43**	**3:51**	**3:53**	**3:59**	**4:04**	**4:10**
	3:45	**3:49**	**3:55**	**4:00**	**4:03**	**4:08**	**4:13**	**4:21**	**4:23**	**4:29**	**4:34**	**4:40**
	4:15	**4:19**	**4:25**	**4:30**	**4:33**	**4:38**	**4:43**	**4:51**	**4:53**	**4:59**	**5:04**	**5:10**
	4:45	**4:49**	**4:55**	**5:00**	**5:03**	**5:08**	**5:13**	**5:21**	**5:23**	**5:29**	**5:34**	**5:40**
	5:15	**5:19**	**5:25**	**5:30**	**5:33**	**5:38**	**5:43**	**5:51**	**5:53**	**5:59**	**6:04**	**6:10**
	5:45	**5:49**	**5:55**	**6:00**	**6:03**	**6:08**	**6:13**	**6:21**	**6:23**	**6:29**	**6:34**	**6:40**
	6:15	**6:19**	**6:25**	**6:30**	**6:33**	**6:38**	**6:43**	**6:51**	**6:53**	**6:59**	**7:04**	**7:10**
	6:45	**6:49**	**6:55**	**7:00**	**7:03**	**7:08**	**7:13**	**7:21**	**7:23**	**7:29**	**7:34**	**7:40**
	7:15	**7:19**	**7:25**	**7:30**	**7:33**	**7:38**	**7:43**	**7:51**	**7:53**	**7:59**	**8:04**	**8:10**
	7:45	**7:49**	**7:55**	**8:00**	**8:03**	**8:08**	**8:13**	**8:21**	**8:23**	**8:29**	**8:34**	**8:40**
	8:15	**8:19**	**8:25**	**8:30**	**8:33**	**8:38**	**8:43**	**8:51**	**8:53**	**8:59**	**9:04**	**9:10**
	8:45	**8:49**	**8:55**	**9:00**	**9:03**	**9:08**	**9:13**	**9:21**	**9:23**	**9:29**	**9:34**	**9:40**
	9:15	**9:19**	**9:25**	**9:30**	**9:33**	**9:38**	**9:43**	**9:51**	**9:53**	**9:59**	**10:04**	**10:10**
	9:45	**9:49**	**9:55**	**10:00**	**10:03**	**10:08**	**10:13**	**10:21**	**10:23**	**10:29**	**10:34**	*To Garage*
	10:15	**10:19**	**10:25**	**10:30**	**10:33**	**10:38**	**10:43**	**10:51**	**10:53**	**10:59**	**11:04**	**11:10**
	11:15	**11:19**	**11:25**	**11:30**	**11:33**	**11:38**	**11:43**	**11:51**	**11:53**	**11:59**	**12:04**	*To Garage*
SUNDAY SCHEDULE												
A.M.	8:15	8:19	8:25	8:30	8:33	8:38	8:43	8:51	8:53	8:59	9:04	9:10
	9:15	9:19	9:25	9:30	9:33	9:38	9:43	9:51	9:53	9:59	10:04	10:10
	10:15	10:19	10:25	10:30	10:33	10:38	10:43	10:51	10:53	10:59	11:04	11:10
	11:15	11:19	11:25	11:30	11:33	11:38	11:43	11:51	11:53	11:59	**12:04**	**12:10**
P.M.	**12:15**	**12:19**	**12:25**	**12:30**	**12:33**	**12:38**	**12:43**	**12:51**	**12:53**	**12:59**	**1:04**	**1:10**
	1:15	**1:19**	**1:25**	**1:30**	**1:33**	**1:38**	**1:43**	**1:51**	**1:53**	**1:59**	**2:04**	**2:10**
	2:15	**2:19**	**2:25**	**2:30**	**2:33**	**2:38**	**2:43**	**2:51**	**2:53**	**2:59**	**3:04**	**3:10**
	3:15	**3:19**	**3:25**	**3:30**	**3:33**	**3:38**	**3:43**	**3:51**	**3:53**	**3:59**	**4:04**	**4:10**
	4:15	**4:19**	**4:25**	**4:30**	**4:33**	**4:38**	**4:43**	**4:51**	**4:53**	**4:59**	**5:04**	**5:10**
	5:15	**5:19**	**5:25**	**5:30**	**5:33**	**5:38**	**5:43**	**5:51**	**5:53**	**5:59**	**6:04**	**6:10**
	6:15	**6:19**	**6:25**	**6:30**	**6:33**	**6:38**	**6:43**	**6:51**	**6:53**	**6:59**	**7:04**	**7:10**
	7:15	**7:19**	**7:25**	**7:30**	**7:33**	**7:38**	**7:43**	**7:51**	**7:53**	**7:59**	**8:04**	**8:10**
	8:15	**8:19**	**8:25**	**8:30**	**8:33**	**8:38**	**8:43**	**8:51**	**8:53**	**8:59**	**9:05**	*To Garage*

Need help reading this schedule?
Need other general information on how to ride?
Click here to Download the General Schedule Information pdf available from katbus.com

APPENDIX D

ZONING MAP



Zoning Map

Knoxville - Knox County - KUB Geographic Information System

Printed: 1/5/2021 at 11:54:44 AM

0 390 780 1,560

ft

KGIS makes no representation or warranty as to the accuracy of his map and its information nor to its fitness for use. Any user of this map product accepts the same AS IS ,WITH ALL FAULTS, and assumes all responsibility for the use thereof, and futher covenants and agrees to hold KGIS harmless from any and all damage, loss, or liability arising from any use of this map product.

APPENDIX E

MANUAL TRAFFIC COUNT DATA

TRAFFIC COUNT DATA

Major Street: Asheville Highway - US 11E / US 70 / US 25W / SR 9 (WB-EB)
Minor Street: North Ruggles Ferry Pike / Private Driveway (SB-NB)
Traffic Control: Stop Control on North Ruggles Ferry Pike

1/13/2021 (Wednesday)
Mostly Cloudy, Cold
Conducted by: Ajax Engineering

	North Ruggles Ferry Pike			Asheville Highway			Private Driveway			Asheville Highway				
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND			VEHICLE	PEAK
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	TOTAL	HOUR
7:00 AM	***2***	***0***	***30***	***0***	***258***	***1***	***0***	***0***	***0***	***15***	***80***	***0***	386	**7:00 AM - 8:00 AM**
7:15 AM	***0***	***0***	***37***	***0***	***273***	***1***	***0***	***0***	***0***	***34***	***118***	***1***	464	
7:30 AM	***1***	***0***	***55***	***0***	***336***	***3***	***0***	***0***	***0***	***39***	***147***	***0***	***581***	
7:45 AM	***0***	***0***	***35***	***0***	***262***	***2***	***0***	***0***	***0***	***15***	***151***	***1***	***466***	
8:00 AM	1	0	29	0	219	1	0	0	0	16	111	2	379	
8:15 AM	0	0	23	0	210	0	0	1	0	11	101	2	348	
8:30 AM	0	0	24	0	192	0	0	0	1	6	82	1	306	
8:45 AM	0	2	15	0	160	1	0	0	0	9	111	1	299	
TOTAL	4	2	248	0	1910	9	0	1	1	145	901	8	3229	
11:00 AM	0	0	8	0	135	2	3	0	1	17	117	2	285	
11:15 AM	0	0	13	1	132	0	0	0	2	11	107	5	271	
11:30 AM	0	0	9	1	147	0	2	0	2	14	124	4	303	
11:45 AM	0	0	5	0	141	0	2	0	1	17	127	3	296	
12:00 PM	***0***	***0***	***9***	***2***	***134***	***1***	***1***	***0***	***2***	***10***	***123***	***3***	***285***	**12:00 PM - 1:00 PM**
12:15 PM	***0***	***0***	***17***	***2***	***141***	***1***	***1***	***0***	***1***	***15***	***141***	***2***	***321***	
12:30 PM	***0***	***0***	***20***	***1***	***145***	***0***	***1***	***0***	***1***	***21***	***138***	***3***	***330***	
12:45 PM	***0***	***0***	***12***	***0***	***166***	***1***	***0***	***0***	***1***	***20***	***130***	***1***	***331***	
TOTAL	0	0	93	7	1141	5	10	0	11	125	1007	23	2422	
2:00 PM	0	0	9	1	160	0	1	0	2	19	158	1	351	
2:15 PM	0	0	15	0	162	0	1	0	0	38	136	2	354	
2:30 PM	0	0	20	0	140	1	2	0	1	29	179	5	377	
2:45 PM	0	0	43	2	147	0	0	0	2	33	171	5	403	
3:00 PM	0	0	24	1	143	0	3	0	2	27	211	4	415	
3:15 PM	0	0	13	2	165	0	1	0	2	28	224	6	441	
3:30 PM	0	0	19	0	167	2	1	0	2	31	213	4	439	
3:45 PM	0	0	20	0	203	3	1	0	3	40	246	4	520	
4:00 PM	0	0	22	0	232	5	2	0	0	37	250	4	552	
4:15 PM	0	0	16	1	180	0	1	0	3	25	284	4	514	
4:30 PM	0	1	11	0	186	2	0	0	2	24	242	3	471	
4:45 PM	***0***	***0***	***16***	***0***	***145***	***2***	***1***	***1***	***1***	***39***	***315***	***4***	***524***	**4:45 PM - 5:45 PM**
5:00 PM	***0***	***0***	***14***	***2***	***188***	***1***	***1***	***0***	***1***	***30***	***305***	***0***	***542***	
5:15 PM	***1***	***0***	***12***	***0***	***152***	***1***	***1***	***0***	***1***	***41***	***295***	***1***	***505***	
5:30 PM	***0***	***0***	***16***	***0***	***228***	***1***	***1***	***0***	***0***	***40***	***275***	***1***	***562***	
5:45 PM	0	0	20	1	180	0	1	0	0	20	256	0	478	
TOTAL	1	1	290	10	2778	18	18	1	22	501	3760	48	7448	

2021 AM Peak Hour **7:00 AM - 8:00 AM**

	North Ruggles Ferry Pike			Asheville Highway			Private Driveway			Asheville Highway		
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND		
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT
7:00 AM	2	0	30	0	258	1	0	0	0	15	80	0
7:15 AM	0	0	37	0	273	1	0	0	0	34	118	1
7:30 AM	1	0	55	0	336	3	0	0	0	39	147	0
7:45 AM	0	0	35	0	262	2	0	0	0	15	151	1
TOTAL	**3**	**0**	**157**	**0**	**1129**	**7**	**0**	**0**	**0**	**103**	**496**	**2**
PHF	**0.38**	**-**	**0.71**	**-**	**0.84**	**0.58**	**-**	**-**	**-**	**0.66**	**0.82**	**0.50**

2021 PM Peak Hour **4:45 PM - 5:45 PM**

	North Ruggles Ferry Pike			Asheville Highway			Private Driveway			Asheville Highway		
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND		
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT
4:45 PM	0	0	16	0	145	2	1	1	1	39	315	4
5:00 PM	0	0	14	2	188	1	1	0	1	30	305	0
5:15 PM	1	0	12	0	152	1	1	0	1	41	295	1
5:30 PM	0	0	16	0	228	1	1	0	0	40	275	1
TOTAL	**1**	**0**	**58**	**2**	**713**	**5**	**4**	**1**	**3**	**150**	**1190**	**6**
PHF	**0.25**	**-**	**0.91**	**0.25**	**0.78**	**0.63**	**1.00**	**0.25**	**0.75**	**0.91**	**0.94**	**0.38**

TRAFFIC COUNT DATA

Major Street: Andrew Johnson Highway - US 11E / SR 34 (SB-NB)
Minor Street: North Ruggles Ferry Pike (West Side) / Private Driveway (WB-EB)
Traffic Control: Stop Control on North Ruggles Ferry Pike (West Side)

1/13/2021 (Wednesday)
Mostly Cloudy, Cold
Conducted by: Ajax Engineering

	Andrew Johnson Highway			Private Driveway			Andrew Johnson Highway			North Ruggles Ferry Pike (West Side)				
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND			VEHICLE	PEAK
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	TOTAL	HOUR
7:00 AM	0	205	0	0	0	0	0	58	0	2	0	2	267	
7:15 AM	***0***	***238***	***1***	***0***	***0***	***0***	***0***	***93***	***0***	***9***	***0***	***7***	***348***	**7:15 AM - 8:15 AM**
7:30 AM	***0***	***267***	***1***	***0***	***0***	***0***	***1***	***119***	***0***	***6***	***0***	***9***	***403***	
7:45 AM	***0***	***183***	***8***	***0***	***0***	***0***	***3***	***96***	***0***	***6***	***0***	***1***	***297***	
8:00 AM	***2***	***148***	***2***	***0***	***0***	***0***	***0***	***98***	***0***	***14***	***1***	***3***	***268***	
8:15 AM	0	139	4	0	0	0	3	97	0	4	0	0	247	
8:30 AM	0	164	4	1	0	1	1	70	0	3	0	2	246	
8:45 AM	1	114	1	0	0	1	0	85	0	4	0	1	207	
TOTAL	3	1458	21	1	0	2	8	716	0	48	1	25	2283	
11:00 AM	2	96	3	3	0	1	4	92	0	1	0	1	203	
11:15 AM	2	116	3	2	0	0	2	98	0	1	2	1	227	
11:30 AM	0	116	3	0	2	1	1	90	0	1	0	0	214	
11:45 AM	2	95	3	1	0	2	2	100	0	3	0	1	209	
12:00 PM	***1***	***113***	***3***	***0***	***0***	***3***	***2***	***96***	***0***	***5***	***1***	***4***	***228***	**12:00 PM - 1:00 PM**
12:15 PM	***0***	***104***	***1***	***1***	***0***	***0***	***4***	***98***	***2***	***1***	***0***	***3***	***214***	
12:30 PM	***3***	***134***	***4***	***1***	***1***	***1***	***2***	***109***	***0***	***4***	***1***	***1***	***261***	
12:45 PM	***5***	***109***	***1***	***1***	***0***	***2***	***6***	***123***	***0***	***2***	***0***	***1***	***250***	
TOTAL	15	883	21	9	3	10	23	806	2	18	4	12	1806	
2:00 PM	3	122	3	2	1	1	2	108	0	6	0	3	251	
2:15 PM	1	145	5	0	0	3	1	104	1	4	1	2	267	
2:30 PM	1	124	3	0	0	4	4	120	1	3	0	3	263	
2:45 PM	1	120	2	0	0	2	3	156	0	3	0	2	289	
3:00 PM	4	110	6	0	0	5	4	164	0	3	0	4	300	
3:15 PM	2	124	4	0	0	2	3	184	0	7	2	3	331	
3:30 PM	3	132	8	0	1	0	3	212	0	7	0	1	367	
3:45 PM	1	176	3	0	1	6	3	205	0	3	1	2	401	
4:00 PM	1	148	5	1	0	4	3	223	0	4	0	3	392	
4:15 PM	3	145	7	2	1	5	5	205	1	8	1	3	386	
4:30 PM	1	143	7	0	0	1	4	208	0	8	0	4	376	
4:45 PM	***5***	***152***	***2***	***1***	***0***	***0***	***2***	***258***	***0***	***6***	***1***	***1***	***428***	**4:45 PM - 5:45 PM**
5:00 PM	***1***	***129***	***8***	***1***	***0***	***3***	***1***	***277***	***0***	***8***	***0***	***5***	***433***	
5:15 PM	***2***	***146***	***3***	***0***	***1***	***2***	***5***	***248***	***0***	***8***	***0***	***2***	***417***	
5:30 PM	***0***	***168***	***10***	***1***	***0***	***5***	***0***	***245***	***0***	***8***	***0***	***4***	***441***	
5:45 PM	2	145	3	2	1	3	3	213	0	6	1	1	380	
TOTAL	31	2229	79	10	6	46	46	3130	3	92	7	43	5722	

2021 AM Peak Hour **7:15 AM - 8:15 AM**

	Andrew Johnson Highway			Private Driveway			Andrew Johnson Highway			North Ruggles Ferry Pike (West Side)		
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND		
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT
7:15 AM	0	238	1	0	0	0	0	93	0	9	0	7
7:30 AM	0	267	1	0	0	0	1	119	0	6	0	9
7:45 AM	0	183	8	0	0	0	3	96	0	6	0	1
8:00 AM	2	148	2	0	0	0	0	98	0	14	1	3
TOTAL	**2**	**836**	**12**	**0**	**0**	**0**	**4**	**406**	**0**	**35**	**1**	**20**
PHF	**0.25**	**0.78**	**0.38**	**-**	**-**	**-**	**0.33**	**0.85**	**-**	**0.63**	**0.25**	**0.56**

2021 AM Peak Hour **4:45 PM - 5:45 PM**

	Andrew Johnson Highway			Private Driveway			Andrew Johnson Highway			North Ruggles Ferry Pike (West Side)		
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND		
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT
4:45 PM	5	152	2	1	0	0	2	258	0	6	1	1
5:00 PM	1	129	8	1	0	3	1	277	0	8	0	5
5:15 PM	2	146	3	0	1	2	5	248	0	8	0	2
5:30 PM	0	168	10	1	0	5	0	245	0	8	0	4
TOTAL	**8**	**595**	**23**	**3**	**1**	**10**	**8**	**1028**	**0**	**30**	**1**	**12**
PHF	**0.40**	**0.89**	**0.58**	**0.75**	**0.25**	**0.50**	**0.40**	**0.93**	**-**	**0.94**	**0.25**	**0.60**

TRAFFIC COUNT DATA

Major Street: Andrew Johnson Highway - US 11E / SR 34 (SB-NB) — 1/13/2021 (Wednesday)
Minor Street: North Ruggles Ferry Pike (East Side) (WB) — Mostly Cloudy, Cold
Traffic Control: Stop Control on North Ruggles Ferry Pike (East Side) — Conducted by: Ajax Engineering

	Andrew Johnson Highway		North Ruggles Ferry Pike (East Side)		Andrew Johnson Highway			
TIME	SOUTHBOUND		WESTBOUND		NORTHBOUND		VEHICLE	PEAK
BEGIN	LT	THRU	LT	RT	THRU	RT	TOTAL	HOUR
7:00 AM	0	204	1	0	59	1	265	
7:15 AM	***1***	***238***	***1***	***0***	***101***	***1***	***342***	**7:15 AM - 8:15 AM**
7:30 AM	***0***	***267***	***1***	***0***	***123***	***2***	***393***	
7:45 AM	***1***	***188***	***3***	***1***	***97***	***5***	***295***	
8:00 AM	***1***	***151***	***1***	***0***	***99***	***13***	***265***	
8:15 AM	1	136	7	0	97	4	245	
8:30 AM	1	165	3	1	72	2	244	
8:45 AM	0	113	3	0	84	6	206	
TOTAL	5	1462	20	2	732	34	2255	
11:00 AM	0	100	1	0	94	0	195	
11:15 AM	0	118	3	1	98	2	223	
11:30 AM	2	119	0	0	88	5	215	
11:45 AM	0	98	2	0	102	3	205	
12:00 PM	***0***	***117***	***0***	***0***	***103***	***2***	***223***	**12:00 PM - 1:00 PM**
12:15 PM	***0***	***105***	***0***	***0***	***96***	***3***	***204***	
12:30 PM	***0***	***141***	***0***	***0***	***112***	***3***	***257***	
12:45 PM	***2***	***115***	***0***	***0***	***123***	***5***	***246***	
TOTAL	4	913	6	1	816	23	1763	
2:00 PM	0	126	2	1	114	1	244	
2:15 PM	0	148	3	0	109	3	264	
2:30 PM	0	128	0	0	125	3	257	
2:45 PM	1	121	2	0	158	3	285	
3:00 PM	0	115	5	0	163	9	292	
3:15 PM	1	130	0	0	188	5	324	
3:30 PM	0	135	8	1	211	10	367	
3:45 PM	1	177	3	0	210	5	397	
4:00 PM	1	150	4	0	229	3	388	
4:15 PM	0	154	1	0	210	8	373	
4:30 PM	1	150	1	0	208	9	369	
4:45 PM	***0***	***155***	***4***	***0***	***256***	***9***	***425***	**4:45 PM - 5:45 PM**
5:00 PM	***0***	***133***	***5***	***2***	***276***	***12***	***428***	
5:15 PM	***0***	***148***	***3***	***0***	***254***	***5***	***411***	
5:30 PM	***0***	***174***	***4***	***0***	***255***	***3***	***436***	
5:45 PM	0	148	2	0	215	7	372	
TOTAL	5	2292	47	4	3181	95	5624	

2021 AM Peak Hour — **7:15 AM - 8:15 AM**

	Andrew Johnson Highway		North Ruggles Ferry Pike (East Side)		Andrew Johnson Highway	
TIME	SOUTHBOUND		WESTBOUND		NORTHBOUND	
BEGIN	LT	THRU	LT	RT	THRU	RT
7:15 AM	1	238	1	0	101	1
7:30 AM	0	267	1	0	123	2
7:45 AM	1	188	3	1	97	5
8:00 AM	1	151	1	0	99	13
TOTAL	**3**	**844**	**6**	**1**	**420**	**21**
PHF	**0.75**	**0.79**	**0.50**	**0.25**	**0.85**	**0.40**

2021 PM Peak Hour — **4:45 PM - 5:45 PM**

	Andrew Johnson Highway		North Ruggles Ferry Pike (East Side)		Andrew Johnson Highway	
TIME	SOUTHBOUND		WESTBOUND		NORTHBOUND	
BEGIN	LT	THRU	LT	RT	THRU	RT
4:45 PM	0	155	4	0	256	9
5:00 PM	0	133	5	2	276	12
5:15 PM	0	148	3	0	254	5
5:30 PM	0	174	4	0	255	3
TOTAL	**0**	**610**	**16**	**2**	**1041**	**29**
PHF	**-**	**0.88**	**0.80**	**0.25**	**0.94**	**0.60**

TRAFFIC COUNT DATA

Major Street: North Ruggles Ferry Pike (WB-EB)
Minor Street: Burris Road (SB-NB)
Traffic Control: Stop Control on Burris Road

1/13/2021 (Wednesday)
Mostly Cloudy, Cold
Conducted by: Ajax Engineering

	Burris Road			North Ruggles Ferry Pike			Burris Road			North Ruggles Ferry Pike				
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND			VEHICLE	PEAK
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	TOTAL	HOUR
7:00 AM	0	0	0	0	3	0	0	0	1	0	1	3	8	
7:15 AM	***0***	***0***	***0***	***1***	***3***	***0***	***3***	***0***	***0***	***0***	***8***	***0***	***15***	**7:15 AM - 8:15 AM**
7:30 AM	***0***	***0***	***0***	***1***	***3***	***0***	***2***	***0***	***1***	***0***	***8***	***3***	***18***	
7:45 AM	***0***	***0***	***0***	***1***	***8***	***0***	***0***	***0***	***1***	***0***	***6***	***0***	***16***	
8:00 AM	***0***	***0***	***0***	***0***	***2***	***0***	***1***	***0***	***1***	***0***	***10***	***0***	***14***	
8:15 AM	0	0	0	0	2	0	1	0	1	0	4	1	9	
8:30 AM	0	0	0	0	4	0	2	0	0	0	3	2	11	
8:45 AM	0	0	0	0	4	0	0	0	1	0	5	0	10	
TOTAL	0	0	0	3	29	0	9	0	6	0	45	9	101	
11:00 AM	0	0	0	0	2	0	0	0	0	0	2	1	5	
11:15 AM	0	0	0	0	2	0	3	0	0	0	2	2	9	
11:30 AM	0	0	0	1	5	0	0	0	0	0	1	0	7	
11:45 AM	***0***	***0***	***0***	***1***	***4***	***0***	***0***	***0***	***0***	***0***	***6***	***0***	***11***	**11:45 AM - 12:45 PM**
12:00 PM	***0***	***0***	***0***	***0***	***5***	***0***	***0***	***0***	***1***	***0***	***8***	***1***	***15***	
12:15 PM	***0***	***0***	***0***	***0***	***2***	***0***	***0***	***0***	***0***	***0***	***5***	***1***	***8***	
12:30 PM	***0***	***0***	***0***	***0***	***6***	***0***	***0***	***0***	***0***	***0***	***5***	***1***	***12***	
12:45 PM	0	0	0	0	2	0	2	0	0	0	3	0	7	
TOTAL	0	0	0	2	28	0	5	0	1	0	32	6	74	
2:00 PM	0	0	0	0	2	0	0	0	0	0	7	0	9	
2:15 PM	0	0	0	0	5	0	0	0	2	0	4	1	12	
2:30 PM	0	0	0	0	3	0	0	0	1	0	5	1	10	
2:45 PM	0	0	0	0	3	0	2	0	1	0	6	0	12	
3:00 PM	0	0	0	2	8	0	2	0	0	0	4	2	18	
3:15 PM	0	0	0	0	4	0	1	0	1	0	11	1	18	
3:30 PM	0	0	1	0	6	0	1	0	0	0	7	0	15	
3:45 PM	0	0	0	2	6	0	1	0	1	0	6	2	18	
4:00 PM	0	0	0	0	3	0	1	0	1	0	7	0	12	
4:15 PM	***0***	***0***	***1***	***3***	***8***	***0***	***0***	***0***	***1***	***1***	***15***	***0***	***29***	**4:15 PM - 5:15 PM**
4:30 PM	***0***	***0***	***0***	***0***	***10***	***0***	***1***	***0***	***0***	***1***	***10***	***3***	***25***	
4:45 PM	***0***	***0***	***0***	***0***	***4***	***1***	***1***	***0***	***1***	***0***	***9***	***2***	***18***	
5:00 PM	***0***	***0***	***0***	***1***	***11***	***0***	***2***	***0***	***0***	***0***	***14***	***0***	***28***	
5:15 PM	0	0	0	1	3	0	0	0	1	0	7	3	15	
5:30 PM	0	0	0	1	7	0	6	0	0	0	9	1	24	
5:45 PM	0	0	0	0	6	0	0	1	1	0	12	0	20	
TOTAL	0	0	2	10	89	1	18	1	11	2	133	16	283	

2021 AM Peak Hour **7:15 AM - 8:15 AM**

	Burris Road			North Ruggles Ferry Pike			Burris Road			North Ruggles Ferry Pike		
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND		
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT
7:15 AM	0	0	0	1	3	0	3	0	0	0	8	0
7:30 AM	0	0	0	1	3	0	2	0	1	0	8	3
7:45 AM	0	0	0	1	8	0	0	0	1	0	6	0
8:00 AM	0	0	0	0	2	0	1	0	1	0	10	0
TOTAL	**0**	**0**	**0**	**3**	**16**	**0**	**6**	**0**	**3**	**0**	**32**	**3**
PHF	**-**	**-**	**-**	**0.75**	**0.50**	**-**	**0.50**	**-**	**0.75**	**-**	**0.80**	**0.25**

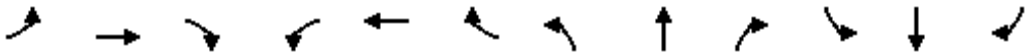
2021 PM Peak Hour **4:15 PM - 5:15 PM**

	Burris Road			North Ruggles Ferry Pike			Burris Road			North Ruggles Ferry Pike		
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND		
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT
4:15 PM	0	0	1	3	8	0	0	0	1	1	15	0
4:30 PM	0	0	0	0	10	0	1	0	0	1	10	3
4:45 PM	0	0	0	0	4	1	1	0	1	0	9	2
5:00 PM	0	0	0	1	11	0	2	0	0	0	14	0
TOTAL	**0**	**0**	**1**	**4**	**33**	**1**	**4**	**0**	**2**	**2**	**48**	**5**
PHF	**-**	**-**	**0.25**	**0.33**	**0.75**	**0.25**	**0.50**	**-**	**0.50**	**0.50**	**0.80**	**0.42**

APPENDIX F

CAPACITY ANALYSES – HCM WORKSHEETS (SYNCHRO 8)

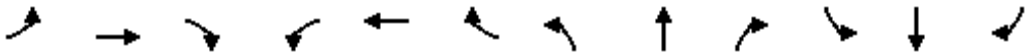
EXISTING TRAFFIC CONDITIONS



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	103	496	2	0	1129	7	0	0	0	3	0	157
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			4%			8%			-8%	
Peak Hour Factor	0.66	0.82	0.50	0.90	0.84	0.58	0.90	0.90	0.90	0.38	0.90	0.71
Hourly flow rate (vph)	156	605	4	0	1344	12	0	0	0	8	0	221
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1356			609			1812	2275	304	1965	2271	678
vC1, stage 1 conf vol							919	919		1350	1350	
vC2, stage 2 conf vol							893	1356		615	921	
vCu, unblocked vol	1356			609			1812	2275	304	1965	2271	678
tC, single (s)	4.2			4.1			7.5	6.5	6.9	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	69			100			100	100	100	93	100	42
cM capacity (veh/h)	498			980			16	52	697	109	119	381

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	156	403	206	672	684	0	229
Volume Left	156	0	0	0	0	0	8
Volume Right	0	0	4	0	12	0	221
cSH	498	1700	1700	980	1700	1700	351
Volume to Capacity	0.31	0.24	0.12	0.00	0.40	0.00	0.65
Queue Length 95th (ft)	33	0	0	0	0	0	109
Control Delay (s)	15.5	0.0	0.0	0.0	0.0	0.0	32.5
Lane LOS	C					A	D
Approach Delay (s)	3.2			0.0		0.0	32.5
Approach LOS						A	D

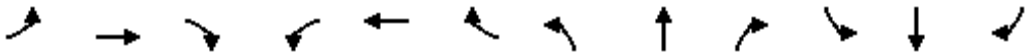
Intersection Summary				
Average Delay	4.2			
Intersection Capacity Utilization	65.1%	ICU Level of Service	C	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	35	1	20	0	0	0	4	406	0	2	836	12
Sign Control		Stop			Stop			Free			Free	
Grade		4%			-6%			1%			-1%	
Peak Hour Factor	0.94	0.25	0.60	0.90	0.90	0.90	0.33	0.85	0.90	0.25	0.78	0.38
Hourly flow rate (vph)	37	4	33	0	0	0	12	478	0	8	1072	32
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1367	1605	552	1089	1621	239	1103			478		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1367	1605	552	1089	1621	239	1103			478		
tC, single (s)	7.6	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	64	96	93	100	100	100	98			99		
cM capacity (veh/h)	103	103	482	153	102	769	640			1095		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	75	0	12	318	159	544	567
Volume Left	37	0	12	0	0	8	0
Volume Right	33	0	0	0	0	0	32
cSH	158	1700	640	1700	1700	1095	1700
Volume to Capacity	0.47	0.00	0.02	0.19	0.09	0.01	0.33
Queue Length 95th (ft)	55	0	1	0	0	1	0
Control Delay (s)	46.5	0.0	10.7	0.0	0.0	0.2	0.0
Lane LOS	E	A	B			A	
Approach Delay (s)	46.5	0.0	0.3			0.1	
Approach LOS	E	A					

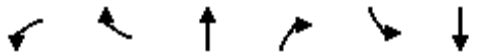
Intersection Summary				
Average Delay	2.2			
Intersection Capacity Utilization	34.9%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	32	3	3	16	0	6	0	3	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			2%			-7%			3%	
Peak Hour Factor	0.90	0.80	0.25	0.75	0.50	0.90	0.50	0.90	0.75	0.90	0.90	0.90
Hourly flow rate (vph)	0	40	12	4	32	0	12	0	4	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	32			52			86	86	46	90	92	32
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	32			52			86	86	46	90	92	32
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			99	100	100	100	100	100
cM capacity (veh/h)	1593			1567			903	806	1029	894	800	1048

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	52	36	16	0
Volume Left	0	4	12	0
Volume Right	12	0	4	0
cSH	1593	1567	932	1700
Volume to Capacity	0.00	0.00	0.02	0.00
Queue Length 95th (ft)	0	0	1	0
Control Delay (s)	0.0	0.8	8.9	0.0
Lane LOS		A	A	A
Approach Delay (s)	0.0	0.8	8.9	0.0
Approach LOS			A	A

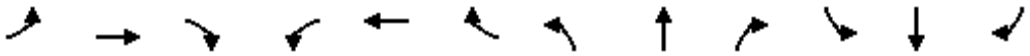
Intersection Summary				
Average Delay	1.7			
Intersection Capacity Utilization	13.4%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	6	1	420	21	3	844
Sign Control	Stop		Free			Free
Grade	0%		0%			-1%
Peak Hour Factor	0.50	0.25	0.85	0.40	0.75	0.79
Hourly flow rate (vph)	12	4	494	52	4	1068
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1063	273			547	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1063	273			547	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	95	99			100	
cM capacity (veh/h)	221	730			1033	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	16	329	217	360	712
Volume Left	12	0	0	4	0
Volume Right	4	0	52	0	0
cSH	267	1700	1700	1033	1700
Volume to Capacity	0.06	0.19	0.13	0.00	0.42
Queue Length 95th (ft)	5	0	0	0	0
Control Delay (s)	19.3	0.0	0.0	0.1	0.0
Lane LOS	C			A	
Approach Delay (s)	19.3	0.0		0.0	
Approach LOS	C				

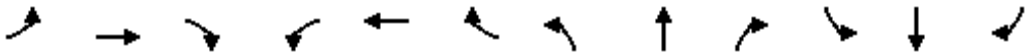
Intersection Summary			
Average Delay	0.2		
Intersection Capacity Utilization	35.4%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	124	595	2	0	1355	8	0	0	0	4	0	188
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			4%			8%			-8%	
Peak Hour Factor	0.66	0.82	0.50	0.90	0.84	0.58	0.90	0.90	0.90	0.38	0.90	0.71
Hourly flow rate (vph)	188	726	4	0	1613	14	0	0	0	11	0	265
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1627			730			2175	2730	365	2359	2725	813
vC1, stage 1 conf vol							1103	1103		1620	1620	
vC2, stage 2 conf vol							1071	1627		739	1105	
vCu, unblocked vol	1627			730			2175	2730	365	2359	2725	813
tC, single (s)	4.2			4.1			7.5	6.5	6.9	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	52			100			100	100	100	85	100	14
cM capacity (veh/h)	391			884			2	11	637	70	77	310

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	188	484	246	807	820	0	275
Volume Left	188	0	0	0	0	0	11
Volume Right	0	0	4	0	14	0	265
cSH	391	1700	1700	884	1700	1700	274
Volume to Capacity	0.48	0.28	0.14	0.00	0.48	0.00	1.01
Queue Length 95th (ft)	63	0	0	0	0	0	257
Control Delay (s)	22.4	0.0	0.0	0.0	0.0	0.0	96.8
Lane LOS	C					A	F
Approach Delay (s)	4.6			0.0		0.0	96.8
Approach LOS						A	F

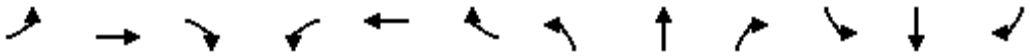
Intersection Summary				
Average Delay	10.9			
Intersection Capacity Utilization	76.1%	ICU Level of Service	D	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	42	1	24	0	0	0	5	487	0	2	1003	14
Sign Control		Stop			Stop			Free			Free	
Grade		4%			-6%			1%			-1%	
Peak Hour Factor	0.94	0.25	0.60	0.90	0.90	0.90	0.33	0.85	0.90	0.25	0.78	0.38
Hourly flow rate (vph)	45	4	40	0	0	0	15	573	0	8	1286	37
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1637	1924	661	1304	1942	286	1323			573		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1637	1924	661	1304	1942	286	1323			573		
tC, single (s)	7.6	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	30	94	90	100	100	100	97			99		
cM capacity (veh/h)	64	65	409	101	64	717	529			1010		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	89	0	15	382	191	651	680
Volume Left	45	0	15	0	0	8	0
Volume Right	40	0	0	0	0	0	37
cSH	103	1700	529	1700	1700	1010	1700
Volume to Capacity	0.86	0.00	0.03	0.22	0.11	0.01	0.40
Queue Length 95th (ft)	123	0	2	0	0	1	0
Control Delay (s)	128.9	0.0	12.0	0.0	0.0	0.2	0.0
Lane LOS	F	A	B			A	
Approach Delay (s)	128.9	0.0	0.3			0.1	
Approach LOS	F	A					

Intersection Summary				
Average Delay	5.9			
Intersection Capacity Utilization	40.1%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	38	4	4	19	0	7	0	4	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			2%			-7%			3%	
Peak Hour Factor	0.90	0.80	0.25	0.75	0.50	0.90	0.50	0.90	0.75	0.90	0.90	0.90
Hourly flow rate (vph)	0	48	16	5	38	0	14	0	5	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	38			64			104	104	56	110	112	38
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	38			64			104	104	56	110	112	38
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			98	100	99	100	100	100
cM capacity (veh/h)	1585			1552			879	787	1017	867	779	1040

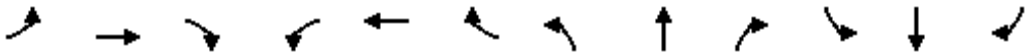
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	64	43	19	0
Volume Left	0	5	14	0
Volume Right	16	0	5	0
cSH	1585	1552	913	1700
Volume to Capacity	0.00	0.00	0.02	0.00
Queue Length 95th (ft)	0	0	2	0
Control Delay (s)	0.0	0.9	9.0	0.0
Lane LOS		A	A	A
Approach Delay (s)	0.0	0.9	9.0	0.0
Approach LOS			A	A

Intersection Summary				
Average Delay	1.7			
Intersection Capacity Utilization	14.4%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	7	1	504	25	4	1013
Sign Control	Stop		Free			Free
Grade	0%		0%			-1%
Peak Hour Factor	0.50	0.25	0.85	0.40	0.75	0.79
Hourly flow rate (vph)	14	4	593	62	5	1282
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1276	328			655	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1276	328			655	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	91	99			99	
cM capacity (veh/h)	160	674			941	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	18	395	260	433	855
Volume Left	14	0	0	5	0
Volume Right	4	0	62	0	0
cSH	193	1700	1700	941	1700
Volume to Capacity	0.09	0.23	0.15	0.01	0.50
Queue Length 95th (ft)	8	0	0	0	0
Control Delay (s)	25.6	0.0	0.0	0.2	0.0
Lane LOS	D			A	
Approach Delay (s)	25.6	0.0		0.1	
Approach LOS	D				

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	40.8%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	150	1190	6	2	713	5	4	1	3	1	0	58
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			4%			8%			-8%	
Peak Hour Factor	0.91	0.94	0.38	0.25	0.78	0.63	1.00	0.25	0.75	0.25	0.90	0.91
Hourly flow rate (vph)	165	1266	16	8	914	8	4	4	4	4	0	64
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	922			1282			2140	2542	641	1903	2545	461
vC1, stage 1 conf vol							1604	1604		934	934	
vC2, stage 2 conf vol							537	938		969	1611	
vCu, unblocked vol	922			1282			2140	2542	641	1903	2545	461
tC, single (s)	4.2			4.1			7.5	6.5	6.9	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.3			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	77			99			94	95	99	97	100	88
cM capacity (veh/h)	712			548			66	76	422	121	88	532

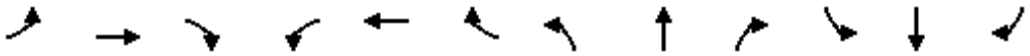
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	165	844	438	465	465	12	68
Volume Left	165	0	0	8	0	4	4
Volume Right	0	0	16	0	8	4	64
cSH	712	1700	1700	548	1700	98	443
Volume to Capacity	0.23	0.50	0.26	0.01	0.27	0.12	0.15
Queue Length 95th (ft)	22	0	0	1	0	10	13
Control Delay (s)	11.6	0.0	0.0	0.4	0.0	47.0	14.6
Lane LOS	B			A		E	B
Approach Delay (s)	1.3			0.2		47.0	14.6
Approach LOS						E	B

Intersection Summary				
Average Delay	1.5			
Intersection Capacity Utilization	66.7%	ICU Level of Service	C	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	30	1	12	3	1	10	8	1028	0	8	595	23
Sign Control		Stop			Stop			Free			Free	
Grade		4%			-6%			1%			-1%	
Peak Hour Factor	0.94	0.25	0.60	0.75	0.25	0.50	0.40	0.93	0.90	0.40	0.89	0.58
Hourly flow rate (vph)	32	4	20	4	4	20	20	1105	0	20	669	40
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1343	1874	354	1542	1894	553	708			1105		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1343	1874	354	1542	1894	553	708			1105		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	68	94	97	94	94	96	98			97		
cM capacity (veh/h)	98	69	648	71	67	483	900			639		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	56	28	20	737	368	354	374
Volume Left	32	4	20	0	0	20	0
Volume Right	20	20	0	0	0	0	40
cSH	135	179	900	1700	1700	639	1700
Volume to Capacity	0.41	0.16	0.02	0.43	0.22	0.03	0.22
Queue Length 95th (ft)	45	14	2	0	0	2	0
Control Delay (s)	49.3	28.9	9.1	0.0	0.0	1.0	0.0
Lane LOS	E	D	A			A	
Approach Delay (s)	49.3	28.9	0.2			0.5	
Approach LOS	E	D					

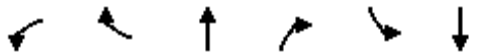
Intersection Summary				
Average Delay	2.1			
Intersection Capacity Utilization	41.6%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	48	5	4	33	1	4	0	2	0	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			2%			-7%			3%	
Peak Hour Factor	0.50	0.80	0.42	0.33	0.75	0.25	0.50	0.90	0.50	0.25	0.90	0.90
Hourly flow rate (vph)	4	60	12	12	44	4	8	0	4	0	0	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	48			72			145	146	66	148	150	46
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	48			72			145	146	66	148	150	46
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			99	100	100	100	100	100
cM capacity (veh/h)	1572			1541			821	742	1004	815	737	1029

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	76	60	12	1
Volume Left	4	12	8	0
Volume Right	12	4	4	1
cSH	1572	1541	874	1029
Volume to Capacity	0.00	0.01	0.01	0.00
Queue Length 95th (ft)	0	1	1	0
Control Delay (s)	0.4	1.5	9.2	8.5
Lane LOS	A	A	A	A
Approach Delay (s)	0.4	1.5	9.2	8.5
Approach LOS			A	A

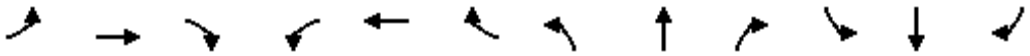
Intersection Summary				
Average Delay	1.6			
Intersection Capacity Utilization	14.0%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	16	2	1041	29	0	610
Sign Control	Stop		Free			Free
Grade	0%		0%			-1%
Peak Hour Factor	0.80	0.25	0.94	0.60	0.90	0.88
Hourly flow rate (vph)	20	8	1107	48	0	693
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1478	578			1156	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1478	578			1156	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	83	98			100	
cM capacity (veh/h)	119	464			612	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	28	738	417	231	462
Volume Left	20	0	0	0	0
Volume Right	8	0	48	0	0
cSH	151	1700	1700	612	1700
Volume to Capacity	0.19	0.43	0.25	0.00	0.27
Queue Length 95th (ft)	16	0	0	0	0
Control Delay (s)	34.2	0.0	0.0	0.0	0.0
Lane LOS	D				
Approach Delay (s)	34.2	0.0		0.0	
Approach LOS	D				

Intersection Summary			
Average Delay	0.5		
Intersection Capacity Utilization	39.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	180	1428	7	2	856	6	5	1	4	1	0	70
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			4%			8%			-8%	
Peak Hour Factor	0.91	0.94	0.38	0.25	0.78	0.63	1.00	0.25	0.75	0.25	0.90	0.91
Hourly flow rate (vph)	198	1519	18	8	1097	10	5	4	5	4	0	77
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1107			1538			2566	3047	769	2281	3051	553
vC1, stage 1 conf vol							1924	1924		1118	1118	
vC2, stage 2 conf vol							642	1123		1163	1933	
vCu, unblocked vol	1107			1538			2566	3047	769	2281	3051	553
tC, single (s)	4.2			4.1			7.5	6.5	6.9	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.3			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	67			98			86	90	98	95	100	83
cM capacity (veh/h)	604			438			36	39	348	79	53	462

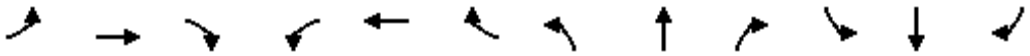
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	198	1013	525	557	558	14	81
Volume Left	198	0	0	8	0	5	4
Volume Right	0	0	18	0	10	5	77
cSH	604	1700	1700	438	1700	56	373
Volume to Capacity	0.33	0.60	0.31	0.02	0.33	0.26	0.22
Queue Length 95th (ft)	36	0	0	1	0	22	20
Control Delay (s)	13.8	0.0	0.0	0.5	0.0	90.8	17.3
Lane LOS	B			A		F	C
Approach Delay (s)	1.6			0.3		90.8	17.3
Approach LOS						F	C

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	78.0%	ICU Level of Service	D
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	36	1	14	4	1	12	10	1234	0	10	714	28
Sign Control		Stop			Stop			Free			Free	
Grade		4%			-6%			1%			-1%	
Peak Hour Factor	0.94	0.25	0.60	0.75	0.25	0.50	0.40	0.93	0.90	0.40	0.89	0.58
Hourly flow rate (vph)	38	4	23	5	4	24	25	1327	0	25	802	48
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1616	2253	425	1853	2277	663	851			1327		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1616	2253	425	1853	2277	663	851			1327		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	33	90	96	86	89	94	97			95		
cM capacity (veh/h)	57	39	583	39	38	409	797			527		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	66	33	25	885	442	426	449
Volume Left	38	5	25	0	0	25	0
Volume Right	23	24	0	0	0	0	48
cSH	81	111	797	1700	1700	527	1700
Volume to Capacity	0.81	0.30	0.03	0.52	0.26	0.05	0.26
Queue Length 95th (ft)	103	29	2	0	0	4	0
Control Delay (s)	142.4	51.0	9.7	0.0	0.0	1.4	0.0
Lane LOS	F	F	A			A	
Approach Delay (s)	142.4	51.0	0.2			0.7	
Approach LOS	F	F					

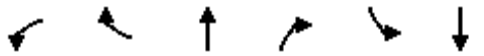
Intersection Summary				
Average Delay	5.1			
Intersection Capacity Utilization	48.0%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	58	6	5	40	1	5	0	2	0	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			2%			-7%			3%	
Peak Hour Factor	0.50	0.80	0.42	0.33	0.75	0.25	0.50	0.90	0.50	0.25	0.90	0.90
Hourly flow rate (vph)	4	72	14	15	53	4	10	0	4	0	0	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	57			87			174	175	80	177	180	55
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	57			87			174	175	80	177	180	55
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			99	100	100	100	100	100
cM capacity (veh/h)	1560			1522			785	713	986	778	708	1017

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	91	72	14	1
Volume Left	4	15	10	0
Volume Right	14	4	4	1
cSH	1560	1522	834	1017
Volume to Capacity	0.00	0.01	0.02	0.00
Queue Length 95th (ft)	0	1	1	0
Control Delay (s)	0.3	1.6	9.4	8.5
Lane LOS	A	A	A	A
Approach Delay (s)	0.3	1.6	9.4	8.5
Approach LOS			A	A

Intersection Summary				
Average Delay	1.6			
Intersection Capacity Utilization	15.8%	ICU Level of Service	A	
Analysis Period (min)	15			

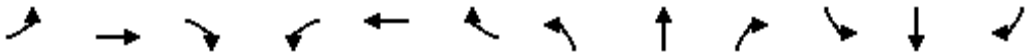


Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	19	2	1249	35	0	732
Sign Control	Stop		Free			Free
Grade	0%		0%			-1%
Peak Hour Factor	0.80	0.25	0.94	0.60	0.90	0.88
Hourly flow rate (vph)	24	8	1329	58	0	832
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1774	694			1387	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1774	694			1387	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	69	98			100	
cM capacity (veh/h)	76	390			500	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	32	886	501	277	555
Volume Left	24	0	0	0	0
Volume Right	8	0	58	0	0
cSH	95	1700	1700	500	1700
Volume to Capacity	0.33	0.52	0.29	0.00	0.33
Queue Length 95th (ft)	32	0	0	0	0
Control Delay (s)	60.9	0.0	0.0	0.0	0.0
Lane LOS	F				
Approach Delay (s)	60.9	0.0		0.0	
Approach LOS	F				

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	45.6%	ICU Level of Service	A
Analysis Period (min)	15		

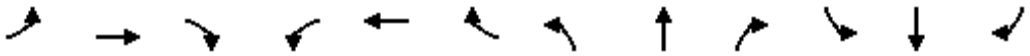
OPENING YEAR TRAFFIC CONDITIONS (WITHOUT THE PROJECT)



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	137	657	2	0	1497	9	0	0	0	4	0	208
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			4%			8%			-8%	
Peak Hour Factor	0.66	0.82	0.50	0.90	0.84	0.58	0.90	0.90	0.90	0.38	0.90	0.71
Hourly flow rate (vph)	208	801	4	0	1782	16	0	0	0	11	0	293
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1798			805			2402	3016	403	2606	3010	899
vC1, stage 1 conf vol							1218	1218		1790	1790	
vC2, stage 2 conf vol							1184	1798		816	1220	
vCu, unblocked vol	1798			805			2402	3016	403	2606	3010	899
tC, single (s)	4.2			4.1			7.5	6.5	6.9	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	38			100			0	100	100	79	100	0
cM capacity (veh/h)	335			828			0	5	602	50	54	271

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	208	534	271	891	907	0	303
Volume Left	208	0	0	0	0	0	11
Volume Right	0	0	4	0	16	0	293
cSH	335	1700	1700	828	1700	1700	235
Volume to Capacity	0.62	0.31	0.16	0.00	0.53	0.00	1.29
Queue Length 95th (ft)	98	0	0	0	0	0	394
Control Delay (s)	31.7	0.0	0.0	0.0	0.0	0.0	200.2
Lane LOS	D					A	F
Approach Delay (s)	6.5			0.0		0.0	200.2
Approach LOS						A	F

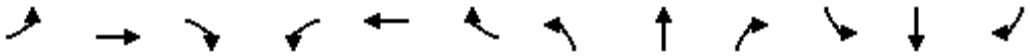
Intersection Summary				
Average Delay	21.6			
Intersection Capacity Utilization	83.0%	ICU Level of Service	E	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	46	1	27	0	0	0	6	538	0	2	1108	15
Sign Control		Stop			Stop			Free			Free	
Grade		4%			-6%			1%			-1%	
Peak Hour Factor	0.94	0.25	0.60	0.90	0.90	0.90	0.33	0.85	0.90	0.25	0.78	0.38
Hourly flow rate (vph)	49	4	45	0	0	0	18	633	0	8	1421	39
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1809	2126	730	1443	2145	316	1460			633		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1809	2126	730	1443	2145	316	1460			633		
tC, single (s)	7.6	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	92	88	100	100	100	96			99		
cM capacity (veh/h)	47	48	369	75	47	686	469			960		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	98	0	18	422	211	718	750
Volume Left	49	0	18	0	0	8	0
Volume Right	45	0	0	0	0	0	39
cSH	78	1700	469	1700	1700	960	1700
Volume to Capacity	1.25	0.00	0.04	0.25	0.12	0.01	0.44
Queue Length 95th (ft)	185	0	3	0	0	1	0
Control Delay (s)	277.4	0.0	13.0	0.0	0.0	0.2	0.0
Lane LOS	F	A	B			A	
Approach Delay (s)	277.4	0.0	0.4			0.1	
Approach LOS	F	A					

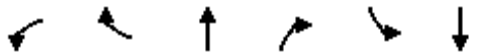
Intersection Summary				
Average Delay	12.4			
Intersection Capacity Utilization	43.4%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	42	4	4	21	0	8	0	4	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			2%			-7%			3%	
Peak Hour Factor	0.90	0.80	0.25	0.75	0.50	0.90	0.50	0.90	0.75	0.90	0.90	0.90
Hourly flow rate (vph)	0	52	16	5	42	0	16	0	5	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	42			68			113	113	60	118	121	42
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	42			68			113	113	60	118	121	42
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			98	100	99	100	100	100
cM capacity (veh/h)	1580			1545			867	778	1011	855	770	1034

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	68	47	21	0
Volume Left	0	5	16	0
Volume Right	16	0	5	0
cSH	1580	1545	899	1700
Volume to Capacity	0.00	0.00	0.02	0.00
Queue Length 95th (ft)	0	0	2	0
Control Delay (s)	0.0	0.8	9.1	0.0
Lane LOS		A	A	A
Approach Delay (s)	0.0	0.8	9.1	0.0
Approach LOS			A	A

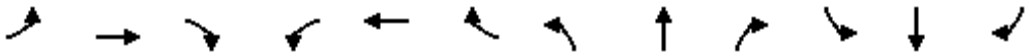
Intersection Summary				
Average Delay	1.7			
Intersection Capacity Utilization	14.5%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	8	1	557	28	4	1119
Sign Control	Stop		Free			Free
Grade	0%		0%			-1%
Peak Hour Factor	0.50	0.25	0.85	0.40	0.75	0.79
Hourly flow rate (vph)	16	4	655	70	5	1416
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1409	363			725	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1409	363			725	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	88	99			99	
cM capacity (veh/h)	131	640			887	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	20	437	288	477	944
Volume Left	16	0	0	5	0
Volume Right	4	0	70	0	0
cSH	156	1700	1700	887	1700
Volume to Capacity	0.13	0.26	0.17	0.01	0.56
Queue Length 95th (ft)	11	0	0	0	0
Control Delay (s)	31.5	0.0	0.0	0.2	0.0
Lane LOS	D			A	
Approach Delay (s)	31.5	0.0		0.1	
Approach LOS	D				

Intersection Summary			
Average Delay	0.3		
Intersection Capacity Utilization	43.7%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	388	1578	8	2	946	7	6	1	4	1	0	137
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			4%			8%			-8%	
Peak Hour Factor	0.91	0.94	0.38	0.25	0.78	0.63	1.00	0.25	0.75	0.25	0.90	0.91
Hourly flow rate (vph)	426	1679	21	8	1213	11	6	4	5	4	0	151
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1224			1700			3315	3782	850	2934	3787	612
vC1, stage 1 conf vol							2542	2542		1234	1234	
vC2, stage 2 conf vol							773	1240		1699	2553	
vCu, unblocked vol	1224			1700			3315	3782	850	2934	3787	612
tC, single (s)	4.2			4.1			7.5	6.5	6.9	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.3			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	22			98			0	0	98	23	100	64
cM capacity (veh/h)	544			380			1	1	307	5	4	422

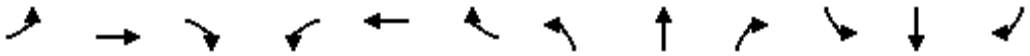
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	426	1119	581	614	618	15	155
Volume Left	426	0	0	8	0	6	4
Volume Right	0	0	21	0	11	5	151
cSH	544	1700	1700	380	1700	1	137
Volume to Capacity	0.78	0.66	0.34	0.02	0.36	12.53	1.13
Queue Length 95th (ft)	182	0	0	2	0	Err	220
Control Delay (s)	31.6	0.0	0.0	0.7	0.0	Err	180.3
Lane LOS	D			A		F	F
Approach Delay (s)	6.3			0.3		Err	180.3
Approach LOS						F	F

Intersection Summary				
Average Delay	55.3			
Intersection Capacity Utilization	88.8%	ICU Level of Service	E	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	108	1	57	4	1	13	40	1364	0	11	789	103
Sign Control		Stop			Stop			Free			Free	
Grade		4%			-6%			1%			-1%	
Peak Hour Factor	0.94	0.25	0.60	0.75	0.25	0.50	0.40	0.93	0.90	0.40	0.89	0.58
Hourly flow rate (vph)	115	4	95	5	4	26	100	1467	0	28	887	178
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1992	2697	532	2262	2786	733	1064			1467		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1992	2697	532	2262	2786	733	1064			1467		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	77	81	59	74	93	85			94		
cM capacity (veh/h)	23	17	497	13	15	368	662			466		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	214	35	100	978	489	471	621
Volume Left	115	5	100	0	0	28	0
Volume Right	95	26	0	0	0	0	178
cSH	40	48	662	1700	1700	466	1700
Volume to Capacity	5.39	0.74	0.15	0.58	0.29	0.06	0.37
Queue Length 95th (ft)	Err	74	13	0	0	5	0
Control Delay (s)	Err	190.8	11.4	0.0	0.0	1.8	0.0
Lane LOS	F	F	B			A	
Approach Delay (s)	Err	190.8	0.7			0.8	
Approach LOS	F	F					

Intersection Summary				
Average Delay	738.6			
Intersection Capacity Utilization	60.6%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	156	7	6	44	101	6	0	2	0	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			2%			-7%			3%	
Peak Hour Factor	0.50	0.80	0.42	0.33	0.75	0.25	0.50	0.90	0.50	0.25	0.90	0.90
Hourly flow rate (vph)	4	195	17	18	59	404	12	0	4	0	0	1
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	463			212			509	710	203	512	517	261
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	463			212			509	710	203	512	517	261
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			97	100	100	100	100	100
cM capacity (veh/h)	1109			1371			472	356	843	467	457	783

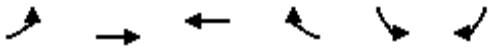
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	216	481	16	1
Volume Left	4	18	12	0
Volume Right	17	404	4	1
cSH	1109	1371	530	783
Volume to Capacity	0.00	0.01	0.03	0.00
Queue Length 95th (ft)	0	1	2	0
Control Delay (s)	0.2	0.4	12.0	9.6
Lane LOS	A	A	B	A
Approach Delay (s)	0.2	0.4	12.0	9.6
Approach LOS			B	A

Intersection Summary				
Average Delay	0.6			
Intersection Capacity Utilization	24.7%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	49	2	1431	56	0	853
Sign Control	Stop		Free			Free
Grade	0%		0%			-1%
Peak Hour Factor	0.80	0.25	0.94	0.60	0.90	0.88
Hourly flow rate (vph)	61	8	1522	93	0	969
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2054	808			1616	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2054	808			1616	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	98			100	
cM capacity (veh/h)	49	328			409	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	69	1015	601	323	646
Volume Left	61	0	0	0	0
Volume Right	8	0	93	0	0
cSH	54	1700	1700	409	1700
Volume to Capacity	1.27	0.60	0.35	0.00	0.38
Queue Length 95th (ft)	153	0	0	0	0
Control Delay (s)	336.0	0.0	0.0	0.0	0.0
Lane LOS	F				
Approach Delay (s)	336.0	0.0		0.0	
Approach LOS	F				

Intersection Summary			
Average Delay	8.8		
Intersection Capacity Utilization	51.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	189	73	50	0	110	60
Sign Control		Free	Free		Stop	
Grade		-2%	0%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	210	81	56	0	122	67
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	56				557	56
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	56				557	56
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	87				71	93
cM capacity (veh/h)	1562				429	1017

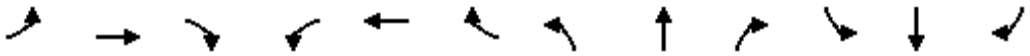
Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	291	56	189
Volume Left	210	0	122
Volume Right	0	0	67
cSH	1562	1700	538
Volume to Capacity	0.13	0.03	0.35
Queue Length 95th (ft)	12	0	39
Control Delay (s)	5.8	0.0	15.3
Lane LOS	A		C
Approach Delay (s)	5.8	0.0	15.3
Approach LOS			C

Intersection Summary			
Average Delay	8.5		
Intersection Capacity Utilization	37.4%	ICU Level of Service	A
Analysis Period (min)	15		

OPENING YEAR TRAFFIC CONDITIONS (WITH PROJECT)

HCM Unsignalized Intersection Capacity Analysis
3: Private Driveway/North Ruggles Ferry Pike & Asheville Highway

2/26/2021



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	167	657	2	0	1497	9	0	0	0	4	0	377
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			4%			8%			-8%	
Peak Hour Factor	0.66	0.82	0.50	0.90	0.84	0.58	0.90	0.90	0.90	0.38	0.90	0.71
Hourly flow rate (vph)	253	801	4	0	1782	16	0	0	0	11	0	531
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1798			805			2731	3107	403	2697	3101	899
vC1, stage 1 conf vol							1309	1309		1790	1790	
vC2, stage 2 conf vol							1422	1798		907	1311	
vCu, unblocked vol	1798			805			2731	3107	403	2697	3101	899
tC, single (s)	4.2			4.1			7.5	6.5	6.9	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	25			100			0	100	100	73	100	0
cM capacity (veh/h)	335			828			0	3	602	38	38	271

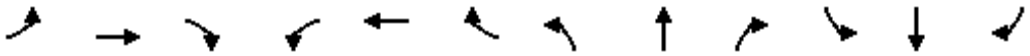
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	253	534	271	891	907	0	542
Volume Left	253	0	0	0	0	0	11
Volume Right	0	0	4	0	16	0	531
cSH	335	1700	1700	828	1700	1700	242
Volume to Capacity	0.75	0.31	0.16	0.00	0.53	0.00	2.23
Queue Length 95th (ft)	147	0	0	0	0	0	1055
Control Delay (s)	42.3	0.0	0.0	0.0	0.0	0.0	600.6
Lane LOS	E					A	F
Approach Delay (s)	10.1			0.0		0.0	600.6
Approach LOS						A	F

Intersection Summary				
Average Delay	98.9			
Intersection Capacity Utilization	93.4%	ICU Level of Service	F	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	98	1	67	0	0	0	23	538	0	2	1108	55
Sign Control		Stop			Stop			Free			Free	
Grade		4%			-6%			1%			-1%	
Peak Hour Factor	0.94	0.25	0.60	0.90	0.90	0.90	0.33	0.85	0.90	0.25	0.78	0.38
Hourly flow rate (vph)	104	4	112	0	0	0	70	633	0	8	1421	145
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1965	2281	783	1612	2354	316	1565			633		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1965	2281	783	1612	2354	316	1565			633		
tC, single (s)	7.6	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	88	67	100	100	100	84			99		
cM capacity (veh/h)	32	33	341	38	30	686	428			960		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	220	0	70	422	211	718	855
Volume Left	104	0	70	0	0	8	0
Volume Right	112	0	0	0	0	0	145
cSH	60	1700	428	1700	1700	960	1700
Volume to Capacity	3.69	0.00	0.16	0.25	0.12	0.01	0.50
Queue Length 95th (ft)	Err	0	14	0	0	1	0
Control Delay (s)	Err	0.0	15.1	0.0	0.0	0.2	0.0
Lane LOS	F	A	C			A	
Approach Delay (s)	Err	0.0	1.5			0.1	
Approach LOS	F	A					

Intersection Summary				
Average Delay	881.6			
Intersection Capacity Utilization	50.0%	ICU Level of Service	A	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	111	4	4	117	0	8	0	4	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			2%			-7%			3%	
Peak Hour Factor	0.90	0.80	0.25	0.75	0.50	0.90	0.50	0.90	0.75	0.90	0.90	0.90
Hourly flow rate (vph)	0	139	16	5	234	0	16	0	5	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	234			155			391	391	147	397	399	234
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	234			155			391	391	147	397	399	234
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			97	100	99	100	100	100
cM capacity (veh/h)	1345			1438			571	546	906	562	539	810

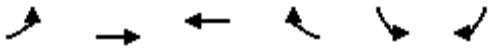
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	155	239	21	0
Volume Left	0	5	16	0
Volume Right	16	0	5	0
cSH	1345	1438	629	1700
Volume to Capacity	0.00	0.00	0.03	0.00
Queue Length 95th (ft)	0	0	3	0
Control Delay (s)	0.0	0.2	10.9	0.0
Lane LOS		A	B	A
Approach Delay (s)	0.0	0.2	10.9	0.0
Approach LOS			B	A

Intersection Summary				
Average Delay	0.7			
Intersection Capacity Utilization	19.4%	ICU Level of Service	A	
Analysis Period (min)	15			

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	28	1	588	49	4	1139
Sign Control	Stop		Free			Free
Grade	0%		0%			-1%
Peak Hour Factor	0.50	0.25	0.85	0.40	0.75	0.79
Hourly flow rate (vph)	56	4	692	122	5	1442
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	1485	407			814	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1485	407			814	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	52	99			99	
cM capacity (veh/h)	117	599			822	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	60	461	353	486	961
Volume Left	56	0	0	5	0
Volume Right	4	0	122	0	0
cSH	124	1700	1700	822	1700
Volume to Capacity	0.49	0.27	0.21	0.01	0.57
Queue Length 95th (ft)	55	0	0	0	0
Control Delay (s)	59.0	0.0	0.0	0.2	0.0
Lane LOS	F			A	
Approach Delay (s)	59.0	0.0		0.1	
Approach LOS	F				

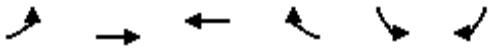
Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	44.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	20	56	88	37	59	110
Sign Control		Free	Free		Stop	
Grade		-2%	0%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	22	62	98	41	66	122
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	139				225	118
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	139				225	118
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				91	87
cM capacity (veh/h)	1457				756	939

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	84	139	188
Volume Left	22	0	66
Volume Right	0	41	122
cSH	1457	1700	866
Volume to Capacity	0.02	0.08	0.22
Queue Length 95th (ft)	1	0	21
Control Delay (s)	2.1	0.0	10.3
Lane LOS	A		B
Approach Delay (s)	2.1	0.0	10.3
Approach LOS			B

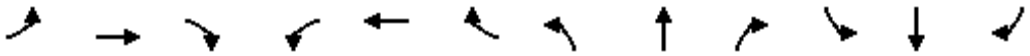
Intersection Summary			
Average Delay	5.1		
Intersection Capacity Utilization	31.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	10	105	62	20	33	59
Sign Control		Free	Free		Stop	
Grade		4%	-4%		-2%	
Peak Hour Factor	0.90	0.80	0.50	0.90	0.90	0.90
Hourly flow rate (vph)	11	131	124	22	37	66
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	146				289	135
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	146				289	135
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	99				95	93
cM capacity (veh/h)	1448				701	919

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	142	146	102
Volume Left	11	0	37
Volume Right	0	22	66
cSH	1448	1700	827
Volume to Capacity	0.01	0.09	0.12
Queue Length 95th (ft)	1	0	11
Control Delay (s)	0.6	0.0	10.0
Lane LOS	A		A
Approach Delay (s)	0.6	0.0	10.0
Approach LOS			A

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	24.9%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	387	1578	8	2	946	7	6	1	4	1	0	136
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			4%			8%			-8%	
Peak Hour Factor	0.91	0.94	0.38	0.25	0.78	0.63	1.00	0.25	0.75	0.25	0.90	0.91
Hourly flow rate (vph)	425	1679	21	8	1213	11	6	4	5	4	0	149
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		Raised			Raised							
Median storage veh)		1			1							
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1224			1700			3312	3780	850	2932	3785	612
vC1, stage 1 conf vol							2540	2540		1234	1234	
vC2, stage 2 conf vol							772	1240		1697	2550	
vCu, unblocked vol	1224			1700			3312	3780	850	2932	3785	612
tC, single (s)	4.2			4.1			7.5	6.5	6.9	7.5	6.5	7.1
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.3			2.2			3.5	4.0	3.3	3.5	4.0	3.4
p0 queue free %	22			98			0	0	98	26	100	65
cM capacity (veh/h)	544			380			1	1	307	5	4	422

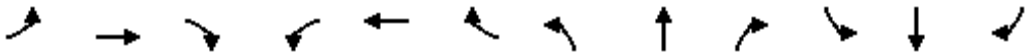
Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	NB 1	SB 1
Volume Total	425	1119	581	614	618	15	153
Volume Left	425	0	0	8	0	6	4
Volume Right	0	0	21	0	11	5	149
cSH	544	1700	1700	380	1700	1	140
Volume to Capacity	0.78	0.66	0.34	0.02	0.36	12.35	1.10
Queue Length 95th (ft)	181	0	0	2	0	Err	212
Control Delay (s)	31.4	0.0	0.0	0.7	0.0	Err	167.1
Lane LOS	D			A		F	F
Approach Delay (s)	6.3			0.3		Err	167.1
Approach LOS						F	F

Intersection Summary				
Average Delay	54.7			
Intersection Capacity Utilization	88.8%	ICU Level of Service	E	
Analysis Period (min)	15			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	108	1	58	4	1	13	40	1364	0	11	789	104
Sign Control		Stop			Stop			Free			Free	
Grade		4%			-6%			1%			-1%	
Peak Hour Factor	0.94	0.25	0.60	0.75	0.25	0.50	0.40	0.93	0.90	0.40	0.89	0.58
Hourly flow rate (vph)	115	4	97	5	4	26	100	1467	0	28	887	179
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1993	2698	533	2264	2787	733	1066			1467		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1993	2698	533	2264	2787	733	1066			1467		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	77	81	59	74	93	85			94		
cM capacity (veh/h)	23	17	496	13	15	368	661			466		

Direction, Lane #	EB 1	WB 1	NB 1	NB 2	NB 3	SB 1	SB 2
Volume Total	216	35	100	978	489	471	623
Volume Left	115	5	100	0	0	28	0
Volume Right	97	26	0	0	0	0	179
cSH	40	47	661	1700	1700	466	1700
Volume to Capacity	5.40	0.74	0.15	0.58	0.29	0.06	0.37
Queue Length 95th (ft)	Err	74	13	0	0	5	0
Control Delay (s)	Err	192.6	11.4	0.0	0.0	1.8	0.0
Lane LOS	F	F	B			A	
Approach Delay (s)	Err	192.6	0.7			0.8	
Approach LOS	F	F					

Intersection Summary				
Average Delay	743.5			
Intersection Capacity Utilization	60.6%	ICU Level of Service	B	
Analysis Period (min)	15			



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	2	204	7	6	131	1	6	0	2	0	0	1
Sign Control		Free			Free			Stop			Stop	
Grade		-2%			2%			-7%			3%	
Peak Hour Factor	0.50	0.80	0.42	0.33	0.75	0.25	0.50	0.90	0.50	0.90	0.90	0.25
Hourly flow rate (vph)	4	255	17	18	175	4	12	0	4	0	0	4
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	179			272			488	486	263	488	493	177
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	179			272			488	486	263	488	493	177
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			98	100	99	100	100	100
cM capacity (veh/h)	1409			1303			486	477	781	484	472	872

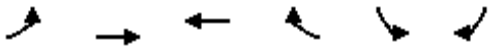
Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	276	197	16	4
Volume Left	4	18	12	0
Volume Right	17	4	4	4
cSH	1409	1303	536	872
Volume to Capacity	0.00	0.01	0.03	0.00
Queue Length 95th (ft)	0	1	2	0
Control Delay (s)	0.1	0.8	11.9	9.1
Lane LOS	A	A	B	A
Approach Delay (s)	0.1	0.8	11.9	9.1
Approach LOS			B	A

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	24.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	49	2	1431	56	0	854
Sign Control	Stop		Free			Free
Grade	0%		0%			-1%
Peak Hour Factor	0.80	0.25	0.94	0.60	0.90	0.88
Hourly flow rate (vph)	61	8	1522	93	0	970
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	2054	808			1616	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2054	808			1616	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	0	98			100	
cM capacity (veh/h)	49	328			409	

Direction, Lane #	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total	69	1015	601	323	647
Volume Left	61	0	0	0	0
Volume Right	8	0	93	0	0
cSH	54	1700	1700	409	1700
Volume to Capacity	1.27	0.60	0.35	0.00	0.38
Queue Length 95th (ft)	153	0	0	0	0
Control Delay (s)	336.5	0.0	0.0	0.0	0.0
Lane LOS	F				
Approach Delay (s)	336.5	0.0		0.0	
Approach LOS	F				

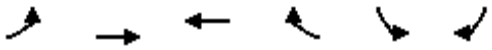
Intersection Summary			
Average Delay	8.8		
Intersection Capacity Utilization	51.3%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	122	141	72	66	72	39
Sign Control		Free	Free		Stop	
Grade		-2%	0%		0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	136	157	80	73	80	43
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	153				544	117
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	153				544	117
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	91				82	95
cM capacity (veh/h)	1440				456	941

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	292	153	123
Volume Left	136	0	80
Volume Right	0	73	43
cSH	1440	1700	557
Volume to Capacity	0.09	0.09	0.22
Queue Length 95th (ft)	8	0	21
Control Delay (s)	4.0	0.0	13.3
Lane LOS	A		B
Approach Delay (s)	4.0	0.0	13.3
Approach LOS			B

Intersection Summary			
Average Delay	5.0		
Intersection Capacity Utilization	38.4%	ICU Level of Service	A
Analysis Period (min)	15		

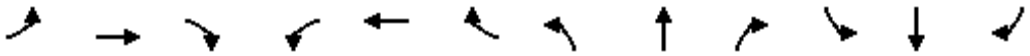


Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (veh/h)	68	138	117	37	39	21
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.90	0.80	0.75	0.90	0.90	0.90
Hourly flow rate (vph)	76	172	156	41	43	23
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	197				500	177
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	197				500	177
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	95				91	97
cM capacity (veh/h)	1388				505	872

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	248	197	67
Volume Left	76	0	43
Volume Right	0	41	23
cSH	1388	1700	592
Volume to Capacity	0.05	0.12	0.11
Queue Length 95th (ft)	4	0	9
Control Delay (s)	2.7	0.0	11.9
Lane LOS	A		B
Approach Delay (s)	2.7	0.0	11.9
Approach LOS			B

Intersection Summary			
Average Delay	2.8		
Intersection Capacity Utilization	32.9%	ICU Level of Service	A
Analysis Period (min)	15		

TRAFFIC SIGNALIZATION



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	42	1	24	0	0	0	5	487	0	2	1003	14
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	12	12	12	12	12	12
Grade (%)		4%			-6%			1%			-1%	
Total Lost time (s)		5.0					5.0	5.0			5.0	
Lane Util. Factor		1.00					1.00	0.95			0.95	
Frt		0.94					1.00	1.00			1.00	
Flt Protected		0.98					0.95	1.00			1.00	
Satd. Flow (prot)		1624					1796	3326			3477	
Flt Permitted		0.84					0.18	1.00			0.95	
Satd. Flow (perm)		1399					339	3326			3312	
Peak-hour factor, PHF	0.94	0.25	0.60	0.90	0.90	0.90	0.33	0.85	0.90	0.25	0.78	0.38
Adj. Flow (vph)	45	4	40	0	0	0	15	573	0	8	1286	37
RTOR Reduction (vph)	0	36	0	0	0	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	53	0	0	0	0	15	573	0	0	1329	0
Heavy Vehicles (%)	3%	0%	0%	0%	0%	0%	0%	8%	0%	0%	4%	0%
Turn Type	Perm	NA					Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		4.5					33.3	33.3			33.3	
Effective Green, g (s)		4.5					33.3	33.3			33.3	
Actuated g/C Ratio		0.09					0.70	0.70			0.70	
Clearance Time (s)		5.0					5.0	5.0			5.0	
Vehicle Extension (s)		3.0					3.0	3.0			3.0	
Lane Grp Cap (vph)		131					236	2317			2307	
v/s Ratio Prot								0.17				
v/s Ratio Perm		c0.04					0.04				c0.40	
v/c Ratio		0.40					0.06	0.25			0.58	
Uniform Delay, d1		20.4					2.3	2.7			3.7	
Progression Factor		1.00					1.00	1.00			1.00	
Incremental Delay, d2		2.0					0.1	0.1			0.4	
Delay (s)		22.4					2.4	2.7			4.0	
Level of Service		C					A	A			A	
Approach Delay (s)		22.4			0.0			2.7			4.0	
Approach LOS		C			A			A			A	

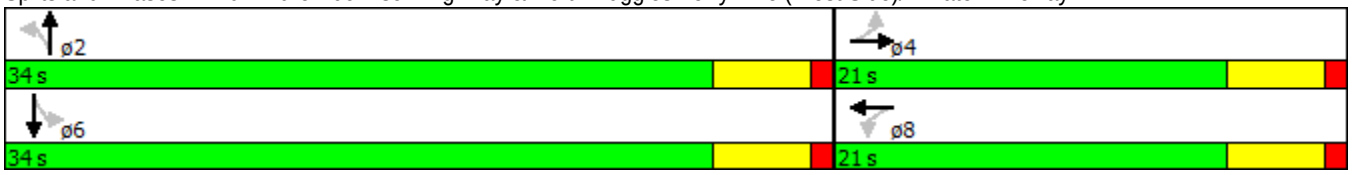
Intersection Summary			
HCM 2000 Control Delay	4.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	47.8	Sum of lost time (s)	10.0
Intersection Capacity Utilization	41.7%	ICU Level of Service	A
Analysis Period (min)	15		

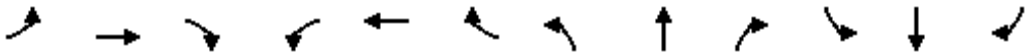
c Critical Lane Group

Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBTL
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Min	None	Min	None
Maximum Split (s)	34	21	34	21
Maximum Split (%)	61.8%	38.2%	61.8%	38.2%
Minimum Split (s)	21	21	21	21
Yellow Time (s)	4	4	4	4
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)	5	5	5	5
Flash Dont Walk (s)	11	11	11	11
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	34	0	34
End Time (s)	34	0	34	0
Yield/Force Off (s)	29	50	29	50
Yield/Force Off 170(s)	29	39	29	39
Local Start Time (s)	0	34	0	34
Local Yield (s)	29	50	29	50
Local Yield 170(s)	29	39	29	39

Intersection Summary	
Cycle Length	55
Control Type	Actuated-Uncoordinated
Natural Cycle	55

Splits and Phases: 10: Andrew Johnson Highway & North Ruggles Ferry Pike (West Side)/Private Driveway





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	124	595	2	0	1355	8	0	0	0	4	0	188
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	11	11	11	11	11	11
Grade (%)		-2%			4%			8%			-8%	
Total Lost time (s)	5.0	5.0			5.0						5.0	
Lane Util. Factor	1.00	0.95			0.95						1.00	
Frt	1.00	1.00			1.00						0.87	
Flt Protected	0.95	1.00			1.00						1.00	
Satd. Flow (prot)	1770	3438			3398						1541	
Flt Permitted	0.10	1.00			1.00						0.99	
Satd. Flow (perm)	180	3438			3398						1528	
Peak-hour factor, PHF	0.66	0.82	0.50	0.90	0.84	0.58	0.90	0.90	0.90	0.38	0.90	0.71
Adj. Flow (vph)	188	726	4	0	1613	14	0	0	0	11	0	265
RTOR Reduction (vph)	0	0	0	0	1	0	0	0	0	0	117	0
Lane Group Flow (vph)	188	730	0	0	1626	0	0	0	0	0	159	0
Heavy Vehicles (%)	3%	6%	0%	0%	4%	0%	0%	0%	0%	0%	0%	8%
Turn Type	pm+pt	NA			NA					Perm	NA	
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	46.3	46.3			36.3						11.6	
Effective Green, g (s)	46.3	46.3			36.3						11.6	
Actuated g/C Ratio	0.68	0.68			0.53						0.17	
Clearance Time (s)	5.0	5.0			5.0						5.0	
Vehicle Extension (s)	3.0	3.0			3.0						3.0	
Lane Grp Cap (vph)	239	2344			1816						261	
v/s Ratio Prot	c0.06	0.21			c0.48							
v/s Ratio Perm	0.48										c0.10	
v/c Ratio	0.79	0.31			0.90						0.61	
Uniform Delay, d1	13.3	4.4			14.1						26.1	
Progression Factor	1.00	1.00			1.00						1.00	
Incremental Delay, d2	15.6	0.1			6.2						4.0	
Delay (s)	28.9	4.4			20.3						30.1	
Level of Service	C	A			C						C	
Approach Delay (s)		9.4			20.3			0.0			30.1	
Approach LOS		A			C			A			C	

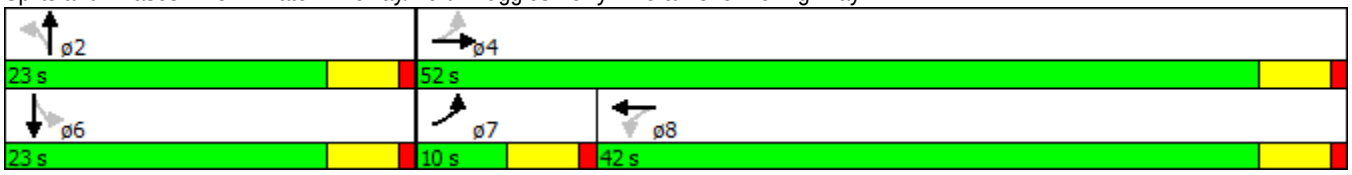
Intersection Summary			
HCM 2000 Control Delay	17.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	67.9	Sum of lost time (s)	15.0
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		

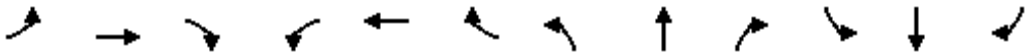
c Critical Lane Group

Phase Number	2	4	6	7	8
Movement	NBTL	EBTL	SBTL	EBL	WBTL
Lead/Lag				Lead	Lag
Lead-Lag Optimize				Yes	Yes
Recall Mode	Min	None	Min	None	None
Maximum Split (s)	23	52	23	10	42
Maximum Split (%)	30.7%	69.3%	30.7%	13.3%	56.0%
Minimum Split (s)	21	21	21	9	21
Yellow Time (s)	4	4	4	4	4
All-Red Time (s)	1	1	1	1	1
Minimum Initial (s)	4	4	4	4	4
Vehicle Extension (s)	3	3	3	3	3
Minimum Gap (s)	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0
Walk Time (s)	5	5	5		5
Flash Dont Walk (s)	11	11	11		11
Dual Entry	Yes	Yes	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes
Start Time (s)	0	23	0	23	33
End Time (s)	23	0	23	33	0
Yield/Force Off (s)	18	70	18	28	70
Yield/Force Off 170(s)	18	59	18	28	59
Local Start Time (s)	0	23	0	23	33
Local Yield (s)	18	70	18	28	70
Local Yield 170(s)	18	59	18	28	59

Intersection Summary	
Cycle Length	75
Control Type	Actuated-Uncoordinated
Natural Cycle	75

Splits and Phases: 3: Private Driveway/North Ruggles Ferry Pike & Asheville Highway





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	36	1	14	4	1	12	10	1234	0	10	714	28
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	12	12	12	12	12	12
Grade (%)		4%			-6%			1%			-1%	
Total Lost time (s)		5.0			5.0		5.0	5.0			5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95			0.95	
Frt		0.95			0.90		1.00	1.00			0.99	
Flt Protected		0.97			0.99		0.95	1.00			1.00	
Satd. Flow (prot)		1665			1752		1796	3522			3436	
Flt Permitted		0.80			0.93		0.32	1.00			0.90	
Satd. Flow (perm)		1373			1647		613	3522			3097	
Peak-hour factor, PHF	0.94	0.25	0.60	0.75	0.25	0.50	0.40	0.93	0.90	0.40	0.89	0.58
Adj. Flow (vph)	38	4	23	5	4	24	25	1327	0	25	802	48
RTOR Reduction (vph)	0	21	0	0	22	0	0	0	0	0	5	0
Lane Group Flow (vph)	0	44	0	0	11	0	25	1327	0	0	870	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	5%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		4.2			4.2		31.0	31.0			31.0	
Effective Green, g (s)		4.2			4.2		31.0	31.0			31.0	
Actuated g/C Ratio		0.09			0.09		0.69	0.69			0.69	
Clearance Time (s)		5.0			5.0		5.0	5.0			5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		127			153		420	2415			2124	
v/s Ratio Prot								c0.38				
v/s Ratio Perm		c0.03			0.01		0.04				0.28	
v/c Ratio		0.35			0.07		0.06	0.55			0.41	
Uniform Delay, d1		19.2			18.7		2.3	3.6			3.1	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		1.7			0.2		0.1	0.3			0.1	
Delay (s)		20.9			18.9		2.4	3.8			3.2	
Level of Service		C			B		A	A			A	
Approach Delay (s)		20.9			18.9			3.8			3.2	
Approach LOS		C			B			A			A	

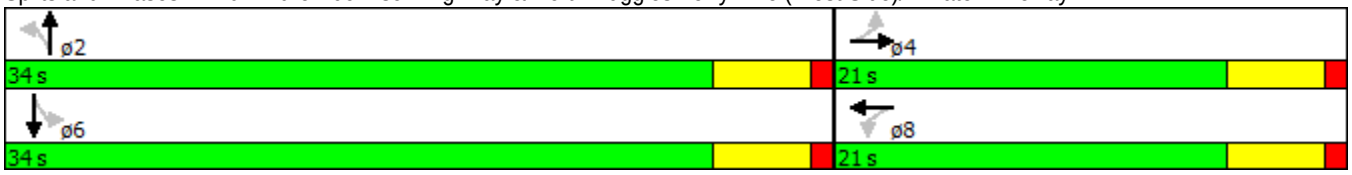
Intersection Summary			
HCM 2000 Control Delay	4.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	45.2	Sum of lost time (s)	10.0
Intersection Capacity Utilization	49.7%	ICU Level of Service	A
Analysis Period (min)	15		

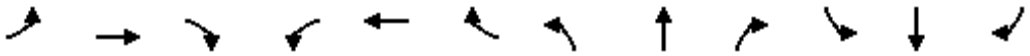
c Critical Lane Group

Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBTL
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Min	None	Min	None
Maximum Split (s)	34	21	34	21
Maximum Split (%)	61.8%	38.2%	61.8%	38.2%
Minimum Split (s)	21	21	21	21
Yellow Time (s)	4	4	4	4
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)	5	5	5	5
Flash Dont Walk (s)	11	11	11	11
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	34	0	34
End Time (s)	34	0	34	0
Yield/Force Off (s)	29	50	29	50
Yield/Force Off 170(s)	29	39	29	39
Local Start Time (s)	0	34	0	34
Local Yield (s)	29	50	29	50
Local Yield 170(s)	29	39	29	39

Intersection Summary	
Cycle Length	55
Control Type	Actuated-Uncoordinated
Natural Cycle	50

Splits and Phases: 10: Andrew Johnson Highway & North Ruggles Ferry Pike (West Side)/Private Driveway





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	180	1428	7	2	856	6	5	1	4	1	0	70
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	11	11	11	11	11	11
Grade (%)		-2%			4%			8%			-8%	
Total Lost time (s)	5.0	5.0			5.0			5.0			5.0	
Lane Util. Factor	1.00	0.95			0.95			1.00			1.00	
Frt	1.00	1.00			1.00			0.95			0.87	
Flt Protected	0.95	1.00			1.00			0.98			1.00	
Satd. Flow (prot)	1720	3569			3431			1649			1544	
Flt Permitted	0.13	1.00			0.94			0.86			0.98	
Satd. Flow (perm)	244	3569			3225			1437			1520	
Peak-hour factor, PHF	0.91	0.94	0.38	0.25	0.78	0.63	1.00	0.25	0.75	0.25	0.90	0.91
Adj. Flow (vph)	198	1519	18	8	1097	10	5	4	5	4	0	77
RTOR Reduction (vph)	0	1	0	0	1	0	0	4	0	0	72	0
Lane Group Flow (vph)	198	1536	0	0	1114	0	0	10	0	0	9	0
Heavy Vehicles (%)	6%	2%	0%	0%	3%	0%	0%	0%	0%	0%	0%	8%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	39.0	39.0			25.5			6.3			6.3	
Effective Green, g (s)	39.0	39.0			25.5			6.3			6.3	
Actuated g/C Ratio	0.71	0.71			0.46			0.11			0.11	
Clearance Time (s)	5.0	5.0			5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	398	2517			1487			163			173	
v/s Ratio Prot	0.08	c0.43										
v/s Ratio Perm	0.27				c0.35			c0.01			0.01	
v/c Ratio	0.50	0.61			0.75			0.06			0.05	
Uniform Delay, d1	6.0	4.2			12.3			21.9			21.8	
Progression Factor	1.00	1.00			1.00			1.00			1.00	
Incremental Delay, d2	1.0	0.4			2.1			0.2			0.1	
Delay (s)	7.0	4.7			14.4			22.0			22.0	
Level of Service	A	A			B			C			C	
Approach Delay (s)		4.9			14.4			22.0			22.0	
Approach LOS		A			B			C			C	

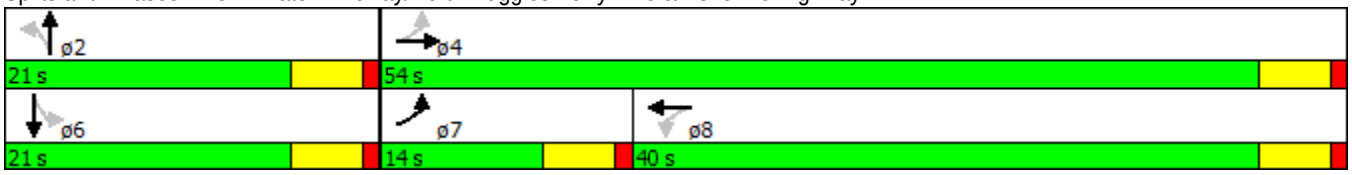
Intersection Summary			
HCM 2000 Control Delay	9.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	55.3	Sum of lost time (s)	15.0
Intersection Capacity Utilization	80.5%	ICU Level of Service	D
Analysis Period (min)	15		

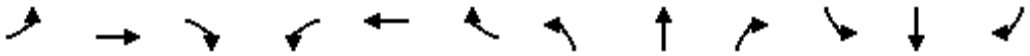
c Critical Lane Group

Phase Number	2	4	6	7	8
Movement	NBTL	EBTL	SBTL	EBL	WBTL
Lead/Lag				Lead	Lag
Lead-Lag Optimize				Yes	Yes
Recall Mode	Min	None	Min	None	None
Maximum Split (s)	21	54	21	14	40
Maximum Split (%)	28.0%	72.0%	28.0%	18.7%	53.3%
Minimum Split (s)	21	21	21	9	21
Yellow Time (s)	4	4	4	4	4
All-Red Time (s)	1	1	1	1	1
Minimum Initial (s)	4	4	4	4	4
Vehicle Extension (s)	3	3	3	3	3
Minimum Gap (s)	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0
Walk Time (s)	5	5	5		5
Flash Dont Walk (s)	11	11	11		11
Dual Entry	Yes	Yes	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes
Start Time (s)	0	21	0	21	35
End Time (s)	21	0	21	35	0
Yield/Force Off (s)	16	70	16	30	70
Yield/Force Off 170(s)	16	59	16	30	59
Local Start Time (s)	0	21	0	21	35
Local Yield (s)	16	70	16	30	70
Local Yield 170(s)	16	59	16	30	59

Intersection Summary	
Cycle Length	75
Control Type	Actuated-Uncoordinated
Natural Cycle	60

Splits and Phases: 3: Private Driveway/North Ruggles Ferry Pike & Asheville Highway





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	98	1	67	0	0	0	23	538	0	2	1108	55
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	12	12	12	12	12	12
Grade (%)		4%			-6%			1%			-1%	
Total Lost time (s)		5.0					5.0	5.0			5.0	
Lane Util. Factor		1.00					1.00	0.95			0.95	
Frt		0.93					1.00	1.00			0.99	
Flt Protected		0.98					0.95	1.00			1.00	
Satd. Flow (prot)		1615					1796	3326			3452	
Flt Permitted		0.85					0.12	1.00			0.95	
Satd. Flow (perm)		1403					219	3326			3288	
Peak-hour factor, PHF	0.94	0.25	0.60	0.90	0.90	0.90	0.33	0.85	0.90	0.25	0.78	0.38
Adj. Flow (vph)	104	4	112	0	0	0	70	633	0	8	1421	145
RTOR Reduction (vph)	0	29	0	0	0	0	0	0	0	0	11	0
Lane Group Flow (vph)	0	191	0	0	0	0	70	633	0	0	1563	0
Heavy Vehicles (%)	3%	0%	0%	0%	0%	0%	0%	8%	0%	0%	4%	0%
Turn Type	Perm	NA					Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		12.2					34.5	34.5			34.5	
Effective Green, g (s)		12.2					34.5	34.5			34.5	
Actuated g/C Ratio		0.22					0.61	0.61			0.61	
Clearance Time (s)		5.0					5.0	5.0			5.0	
Vehicle Extension (s)		3.0					3.0	3.0			3.0	
Lane Grp Cap (vph)		301					133	2023			2000	
v/s Ratio Prot								0.19				
v/s Ratio Perm		c0.14					0.32				c0.48	
v/c Ratio		0.63					0.53	0.31			0.78	
Uniform Delay, d1		20.2					6.4	5.4			8.3	
Progression Factor		1.00					1.00	1.00			1.00	
Incremental Delay, d2		4.3					3.7	0.1			2.1	
Delay (s)		24.6					10.1	5.5			10.3	
Level of Service		C					B	A			B	
Approach Delay (s)		24.6			0.0			5.9			10.3	
Approach LOS		C			A			A			B	

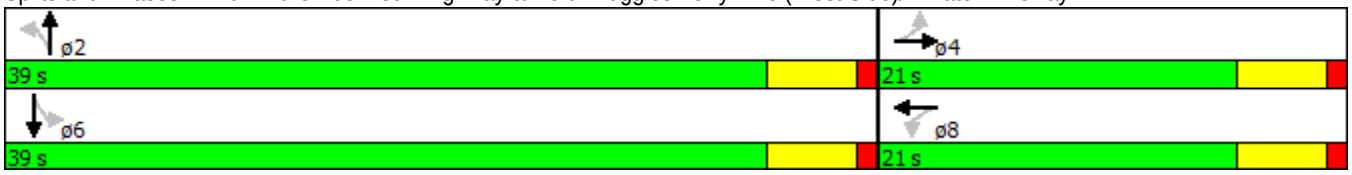
Intersection Summary			
HCM 2000 Control Delay	10.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	56.7	Sum of lost time (s)	10.0
Intersection Capacity Utilization	51.7%	ICU Level of Service	A
Analysis Period (min)	15		

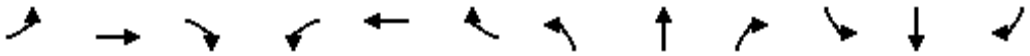
c Critical Lane Group

Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBTL
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Min	None	Min	None
Maximum Split (s)	39	21	39	21
Maximum Split (%)	65.0%	35.0%	65.0%	35.0%
Minimum Split (s)	21	21	21	21
Yellow Time (s)	4	4	4	4
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)	5	5	5	5
Flash Dont Walk (s)	11	11	11	11
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	39	0	39
End Time (s)	39	0	39	0
Yield/Force Off (s)	34	55	34	55
Yield/Force Off 170(s)	34	44	34	44
Local Start Time (s)	0	39	0	39
Local Yield (s)	34	55	34	55
Local Yield 170(s)	34	44	34	44

Intersection Summary	
Cycle Length	60
Control Type	Actuated-Uncoordinated
Natural Cycle	60

Splits and Phases: 10: Andrew Johnson Highway & North Ruggles Ferry Pike (West Side)/Private Driveway





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	167	657	2	0	1497	9	0	0	0	4	0	377
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	11	11	11	11	11	11
Grade (%)		-2%			4%			8%			-8%	
Total Lost time (s)	5.0	5.0			5.0						5.0	
Lane Util. Factor	1.00	0.95			0.95						1.00	
Frt	1.00	1.00			1.00						0.87	
Flt Protected	0.95	1.00			1.00						1.00	
Satd. Flow (prot)	1770	3438			3398						1535	
Flt Permitted	0.07	1.00			1.00						1.00	
Satd. Flow (perm)	124	3438			3398						1531	
Peak-hour factor, PHF	0.66	0.82	0.50	0.90	0.84	0.58	0.90	0.90	0.90	0.38	0.90	0.71
Adj. Flow (vph)	253	801	4	0	1782	16	0	0	0	11	0	531
RTOR Reduction (vph)	0	0	0	0	1	0	0	0	0	0	151	0
Lane Group Flow (vph)	253	805	0	0	1798	0	0	0	0	0	391	0
Heavy Vehicles (%)	3%	6%	0%	0%	4%	0%	0%	0%	0%	0%	0%	8%
Turn Type	pm+pt	NA			NA					Perm	NA	
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	72.0	72.0			55.0						28.0	
Effective Green, g (s)	72.0	72.0			55.0						28.0	
Actuated g/C Ratio	0.65	0.65			0.50						0.25	
Clearance Time (s)	5.0	5.0			5.0						5.0	
Vehicle Extension (s)	3.0	3.0			3.0						3.0	
Lane Grp Cap (vph)	260	2250			1699						389	
v/s Ratio Prot	c0.11	0.23			c0.53							
v/s Ratio Perm	0.53										c0.26	
v/c Ratio	0.97	0.36			1.06						1.01	
Uniform Delay, d1	36.5	8.6			27.5						41.0	
Progression Factor	1.00	1.00			1.00						1.00	
Incremental Delay, d2	48.0	0.1			39.0						47.2	
Delay (s)	84.5	8.7			66.5						88.2	
Level of Service	F	A			E						F	
Approach Delay (s)		26.8			66.5			0.0			88.2	
Approach LOS		C			E			A			F	

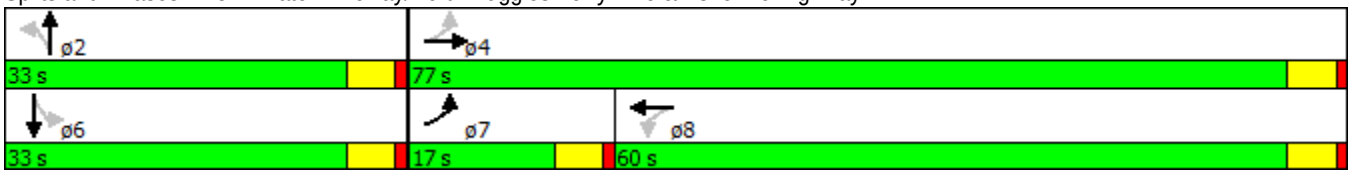
Intersection Summary			
HCM 2000 Control Delay	57.6	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	15.0
Intersection Capacity Utilization	95.9%	ICU Level of Service	F
Analysis Period (min)	15		

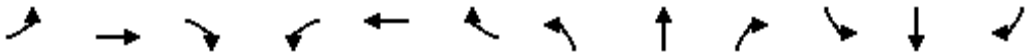
c Critical Lane Group

Phase Number	2	4	6	7	8
Movement	NBTL	EBTL	SBTL	EBL	WBTL
Lead/Lag				Lead	Lag
Lead-Lag Optimize				Yes	Yes
Recall Mode	Min	None	Min	None	None
Maximum Split (s)	33	77	33	17	60
Maximum Split (%)	30.0%	70.0%	30.0%	15.5%	54.5%
Minimum Split (s)	21	21	21	9	21
Yellow Time (s)	4	4	4	4	4
All-Red Time (s)	1	1	1	1	1
Minimum Initial (s)	4	4	4	4	4
Vehicle Extension (s)	3	3	3	3	3
Minimum Gap (s)	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0
Walk Time (s)	5	5	5		5
Flash Dont Walk (s)	11	11	11		11
Dual Entry	Yes	Yes	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes
Start Time (s)	0	33	0	33	50
End Time (s)	33	0	33	50	0
Yield/Force Off (s)	28	105	28	45	105
Yield/Force Off 170(s)	28	94	28	45	94
Local Start Time (s)	0	33	0	33	50
Local Yield (s)	28	105	28	45	105
Local Yield 170(s)	28	94	28	45	94

Intersection Summary	
Cycle Length	110
Control Type	Actuated-Uncoordinated
Natural Cycle	110

Splits and Phases: 3: Private Driveway/North Ruggles Ferry Pike & Asheville Highway





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	108	1	58	4	1	13	40	1364	0	11	789	104
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	12	12	12	12	12	12	12	12	12
Grade (%)		4%			-6%			1%			-1%	
Total Lost time (s)		5.0			5.0		5.0	5.0			5.0	
Lane Util. Factor		1.00			1.00		1.00	0.95			0.95	
Frt		0.94			0.90		1.00	1.00			0.98	
Flt Protected		0.97			0.99		0.95	1.00			1.00	
Satd. Flow (prot)		1647			1748		1796	3522			3397	
Flt Permitted		0.81			0.94		0.22	1.00			0.89	
Satd. Flow (perm)		1377			1660		417	3522			3025	
Peak-hour factor, PHF	0.94	0.25	0.60	0.75	0.25	0.50	0.40	0.93	0.90	0.40	0.89	0.58
Adj. Flow (vph)	115	4	97	5	4	26	100	1467	0	28	887	179
RTOR Reduction (vph)	0	53	0	0	21	0	0	0	0	0	25	0
Lane Group Flow (vph)	0	163	0	0	14	0	100	1467	0	0	1069	0
Heavy Vehicles (%)	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	5%	0%
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)		10.9			10.9		31.3	31.3			31.3	
Effective Green, g (s)		10.9			10.9		31.3	31.3			31.3	
Actuated g/C Ratio		0.21			0.21		0.60	0.60			0.60	
Clearance Time (s)		5.0			5.0		5.0	5.0			5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0			3.0	
Lane Grp Cap (vph)		287			346		250	2111			1813	
v/s Ratio Prot								c0.42				
v/s Ratio Perm		c0.12			0.01		0.24				0.35	
v/c Ratio		0.57			0.04		0.40	0.69			0.59	
Uniform Delay, d1		18.5			16.5		5.5	7.2			6.5	
Progression Factor		1.00			1.00		1.00	1.00			1.00	
Incremental Delay, d2		2.6			0.0		1.1	1.0			0.5	
Delay (s)		21.1			16.5		6.6	8.2			7.0	
Level of Service		C			B		A	A			A	
Approach Delay (s)		21.1			16.5			8.1			7.0	
Approach LOS		C			B			A			A	

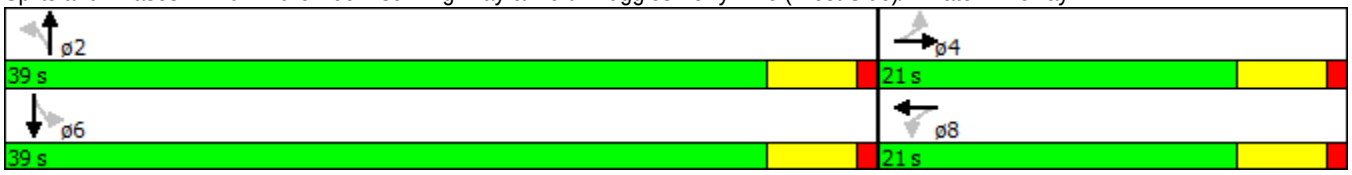
Intersection Summary			
HCM 2000 Control Delay	8.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	52.2	Sum of lost time (s)	10.0
Intersection Capacity Utilization	62.3%	ICU Level of Service	B
Analysis Period (min)	15		

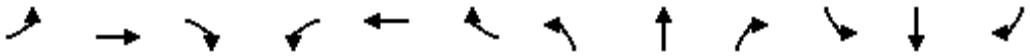
c Critical Lane Group

Phase Number	2	4	6	8
Movement	NBTL	EBTL	SBTL	WBTL
Lead/Lag				
Lead-Lag Optimize				
Recall Mode	Min	None	Min	None
Maximum Split (s)	39	21	39	21
Maximum Split (%)	65.0%	35.0%	65.0%	35.0%
Minimum Split (s)	21	21	21	21
Yellow Time (s)	4	4	4	4
All-Red Time (s)	1	1	1	1
Minimum Initial (s)	4	4	4	4
Vehicle Extension (s)	3	3	3	3
Minimum Gap (s)	3	3	3	3
Time Before Reduce (s)	0	0	0	0
Time To Reduce (s)	0	0	0	0
Walk Time (s)	5	5	5	5
Flash Dont Walk (s)	11	11	11	11
Dual Entry	Yes	Yes	Yes	Yes
Inhibit Max	Yes	Yes	Yes	Yes
Start Time (s)	0	39	0	39
End Time (s)	39	0	39	0
Yield/Force Off (s)	34	55	34	55
Yield/Force Off 170(s)	34	44	34	44
Local Start Time (s)	0	39	0	39
Local Yield (s)	34	55	34	55
Local Yield 170(s)	34	44	34	44

Intersection Summary	
Cycle Length	60
Control Type	Actuated-Uncoordinated
Natural Cycle	60

Splits and Phases: 10: Andrew Johnson Highway & North Ruggles Ferry Pike (West Side)/Private Driveway





Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	387	1578	8	2	946	7	6	1	4	1	0	136
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	12	12	11	11	11	11	11	11
Grade (%)		-2%			4%			8%			-8%	
Total Lost time (s)	4.0	5.0			5.0			5.0			5.0	
Lane Util. Factor	1.00	0.95			0.95			1.00			1.00	
Frt	1.00	1.00			1.00			0.95			0.87	
Flt Protected	0.95	1.00			1.00			0.98			1.00	
Satd. Flow (prot)	1720	3569			3431			1651			1537	
Flt Permitted	0.10	1.00			0.94			0.65			0.99	
Satd. Flow (perm)	174	3569			3220			1092			1526	
Peak-hour factor, PHF	0.91	0.94	0.38	0.25	0.78	0.63	1.00	0.25	0.75	0.25	0.90	0.91
Adj. Flow (vph)	425	1679	21	8	1213	11	6	4	5	4	0	149
RTOR Reduction (vph)	0	1	0	0	1	0	0	5	0	0	136	0
Lane Group Flow (vph)	425	1699	0	0	1231	0	0	10	0	0	17	0
Heavy Vehicles (%)	6%	2%	0%	0%	3%	0%	0%	0%	0%	0%	0%	8%
Turn Type	pm+pt	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases	7	4			8			2			6	
Permitted Phases	4			8			2			6		
Actuated Green, G (s)	65.5	65.5			38.1			7.5			7.5	
Effective Green, g (s)	65.5	65.5			38.1			7.5			7.5	
Actuated g/C Ratio	0.79	0.79			0.46			0.09			0.09	
Clearance Time (s)	4.0	5.0			5.0			5.0			5.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0			3.0	
Lane Grp Cap (vph)	573	2816			1478			98			137	
v/s Ratio Prot	c0.21	0.48										
v/s Ratio Perm	0.38				c0.38			0.01			c0.01	
v/c Ratio	0.74	0.60			0.83			0.11			0.13	
Uniform Delay, d1	19.5	3.5			19.7			34.7			34.7	
Progression Factor	1.00	1.00			1.00			1.00			1.00	
Incremental Delay, d2	5.1	0.4			4.2			0.5			0.4	
Delay (s)	24.6	3.9			23.9			35.2			35.2	
Level of Service	C	A			C			D			D	
Approach Delay (s)		8.0			23.9			35.2			35.2	
Approach LOS		A			C			D			D	

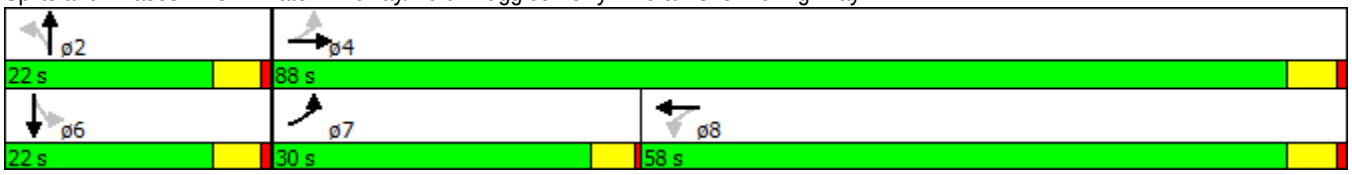
Intersection Summary			
HCM 2000 Control Delay	14.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	83.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	91.3%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Phase Number	2	4	6	7	8
Movement	NBTL	EBTL	SBTL	EBL	WBTL
Lead/Lag				Lead	Lag
Lead-Lag Optimize				Yes	Yes
Recall Mode	Min	None	Min	None	None
Maximum Split (s)	22	88	22	30	58
Maximum Split (%)	20.0%	80.0%	20.0%	27.3%	52.7%
Minimum Split (s)	21	21	21	8	21
Yellow Time (s)	4	4	4	3.5	4
All-Red Time (s)	1	1	1	0.5	1
Minimum Initial (s)	4	4	4	4	4
Vehicle Extension (s)	3	3	3	3	3
Minimum Gap (s)	3	3	3	3	3
Time Before Reduce (s)	0	0	0	0	0
Time To Reduce (s)	0	0	0	0	0
Walk Time (s)	5	5	5		5
Flash Dont Walk (s)	11	11	11		11
Dual Entry	Yes	Yes	Yes	No	Yes
Inhibit Max	Yes	Yes	Yes	Yes	Yes
Start Time (s)	0	22	0	22	52
End Time (s)	22	0	22	52	0
Yield/Force Off (s)	17	105	17	48	105
Yield/Force Off 170(s)	17	94	17	48	94
Local Start Time (s)	0	22	0	22	52
Local Yield (s)	17	105	17	48	105
Local Yield 170(s)	17	94	17	48	94

Intersection Summary	
Cycle Length	110
Control Type	Actuated-Uncoordinated
Natural Cycle	80

Splits and Phases: 3: Private Driveway/North Ruggles Ferry Pike & Asheville Highway



APPENDIX G

ITE TRIP GENERATION RATES

Land Use: 210
Single-Family Detached Housing

Description

Single-family detached housing includes all single-family detached homes on individual lots. A typical site surveyed is a suburban subdivision.

Additional Data

The number of vehicles and residents had a high correlation with average weekday vehicle trip ends. The use of these variables was limited, however, because the number of vehicles and residents was often difficult to obtain or predict. The number of dwelling units was generally used as the independent variable of choice because it was usually readily available, easy to project, and had a high correlation with average weekday vehicle trip ends.

This land use included data from a wide variety of units with different sizes, price ranges, locations, and ages. Consequently, there was a wide variation in trips generated within this category. Other factors, such as geographic location and type of adjacent and nearby development, may also have had an effect on the site trip generation.

Single-family detached units had the highest trip generation rate per dwelling unit of all residential uses because they were the largest units in size and had more residents and more vehicles per unit than other residential land uses; they were generally located farther away from shopping centers, employment areas, and other trip attractors than other residential land uses; and they generally had fewer alternative modes of transportation available because they were typically not as concentrated as other residential land uses.

Time-of-day distribution data for this land use are presented in Appendix A. For the six general urban/suburban sites with data, the overall highest vehicle volumes during the AM and PM on a weekday were counted between 7:15 and 8:15 a.m. and 4:00 and 5:00 p.m., respectively. For the two sites with Saturday data, the overall highest vehicle volume was counted between 3:00 and 4:00 p.m. For the one site with Sunday data, the overall highest vehicle volume was counted between 10:15 and 11:15 a.m.

The sites were surveyed in the 1980s, the 1990s, the 2000s, and the 2010s in California, Connecticut, Delaware, Illinois, Indiana, Maryland, Minnesota, Montana, New Jersey, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Vermont, and Virginia.

Source Numbers

100, 105, 114, 126, 157, 167, 177, 197, 207, 211, 217, 267, 275, 293, 300, 319, 320, 356, 357, 367, 384, 387, 407, 435, 522, 550, 552, 579, 598, 601, 603, 614, 637, 711, 716, 720, 728, 735, 868, 903, 925, 936

Single-Family Detached Housing
(210)

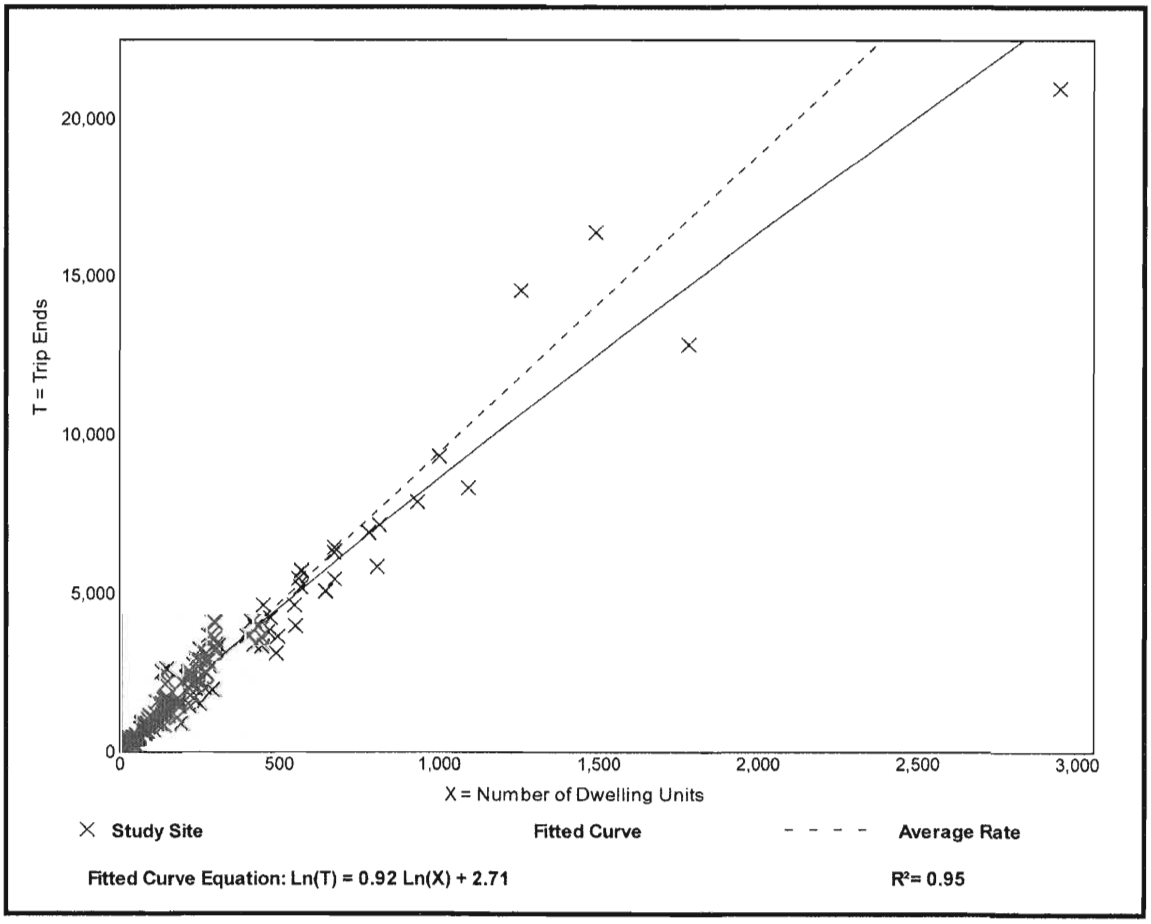
Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday**

Setting/Location: **General Urban/Suburban**
Number of Studies: 159
Avg. Num. of Dwelling Units: 264
Directional Distribution: 50% entering, 50% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
9.44	4.81 - 19.39	2.10

Data Plot and Equation



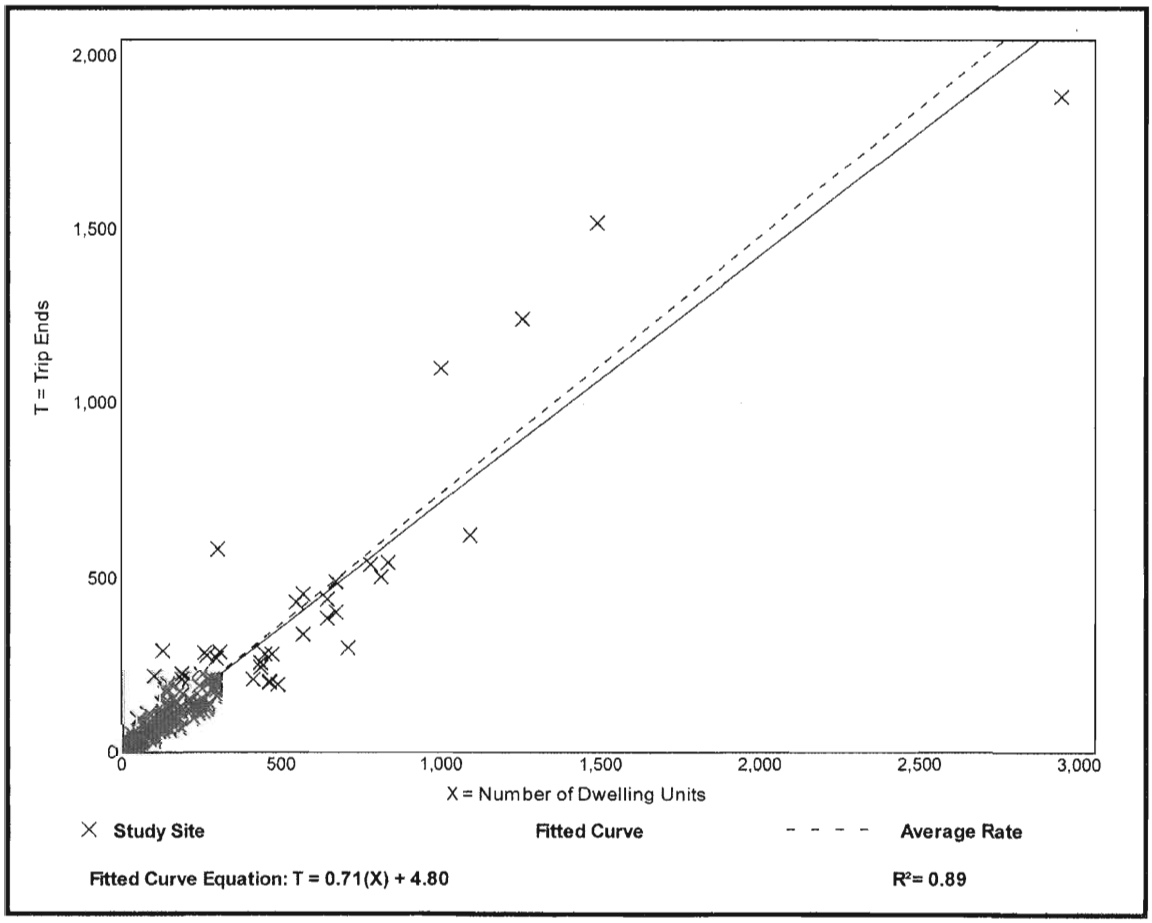
Single-Family Detached Housing
(210)

Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 7 and 9 a.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 173
Avg. Num. of Dwelling Units: 219
Directional Distribution: 25% entering, 75% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.74	0.33 - 2.27	0.27

Data Plot and Equation



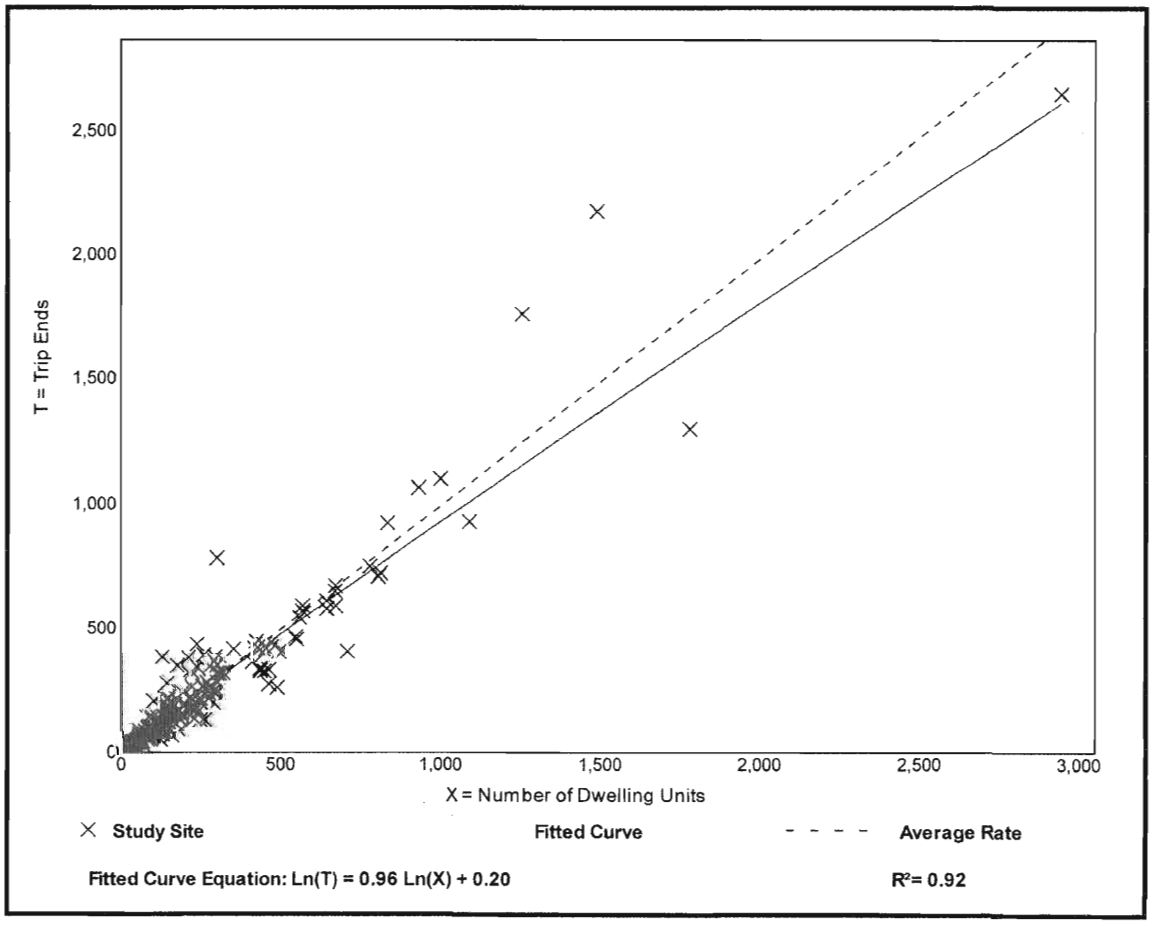
Single-Family Detached Housing
(210)

Vehicle Trip Ends vs: **Dwelling Units**
On a: **Weekday,**
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.
Setting/Location: **General Urban/Suburban**
Number of Studies: 190
Avg. Num. of Dwelling Units: 242
Directional Distribution: 63% entering, 37% exiting

Vehicle Trip Generation per Dwelling Unit

Average Rate	Range of Rates	Standard Deviation
0.99	0.44 - 2.98	0.31

Data Plot and Equation



TRIP GENERATION FOR INNSBRUCK FARMS SUBDIVISION

482 Single-Family Detached Houses

ITE LAND USE CODE	LAND USE DESCRIPTION	UNITS	GENERATED DAILY TRAFFIC	GENERATED TRAFFIC AM PEAK HOUR			GENERATED TRAFFIC PM PEAK HOUR		
				ENTER	EXIT	TOTAL	ENTER	EXIT	TOTAL
#210	Single-Family Detached Housing	482 Houses	4,420	25%	75%		63%	37%	
				87	261	348	290	170	460
Total New Volume Site Trips			**4,420**	**87**	**261**	**348**	**290**	**170**	**460**

ITE Trip Generation Manual, 10th Edition

Trips calculated by using Fitted Curve Equation

TRIP GENERATION FOR INNSBRUCK FARMS SUBDIVISION

482 Single-Family Detached Houses

482 Residential Houses = X

Weekday:

Fitted Curve Equation: Ln(T) = 0.92 Ln(X) + 2.71

Ln(T) = 0.92 * 6.18 + 2.71
Ln(T) = 8.39
T = 4,420 trips

Peak Hour of Adjacent Traffic between 7 and 9 am:

Fitted Curve Equation: T = 0.71(X) + 4.80

T = 0.71 * 482 + 4.80
T = 348 trips

Peak Hour of Adjacent Traffic between 4 and 6 pm:

Fitted Curve Equation: Ln(T) = 0.96 Ln(X) + 0.2

Ln(T) = 0.96 * 6.18 + 0.20
Ln(T) = 6.13
T = 460 trips

APPENDIX H

KNOX COUNTY TURN LANE VOLUME THRESHOLD WORKSHEETS

TABLE 5A

LEFT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

(If the left-turn volume exceeds the table value a left -turn lane is needed)

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	250	180	140	110	80	70
150 - 199	200	140	105	90	70	60
200 - 249	160			75	65	55
250 - 299	130			65	60	50
300 - 349	110			60	55	45
350 - 399	100			55	50	40
400 - 449	90			50	45	35
450 - 499	80			45	40	30
500 - 549	70			35	35	25
550 - 599	65			35	30	25
600 - 649	60	45	35	30	25	25
650 - 699	55	35	35	30	25	20
700 - 749	50	35	30	25	20	20
750 or More	45	35	25	25	20	20

88 + 37= 125

56

100 - 149

North Ruggles Ferry Pike at Road "A"

2028 Projected AM EB Left Turns = 20

Left Turn Lane NOT Warranted

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	=/ >600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	25	25
350 - 399	40	35	30	25	25	20
400 - 449	35	30	30	25	20	20
450 - 499	30	25	25	20	20	20
500 - 549	25	25	20	20	20	15
550 - 599	25	20	20	20	20	15
600 - 649	25	20	20	20	20	15
650 - 699	20	20	20	20	20	15
700 - 749	20	20	20	15	15	15
750 or More	20	20	20	15	15	15

* Or through volume only if a right-turn lane exists

TABLE 5B

RIGHT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

RIGHT-TURN VOLUME	88 THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99						
100 - 149 150 - 199						
200 - 249 250 - 299					Yes	Yes Yes
300 - 349 350 - 399				Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

North Ruggles Ferry Pike at Road "A"

2028 Projected AM WB Right Turns = 37

Right Turn Lane NOT Warranted

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99				Yes	Yes Yes	Yes Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

* Or through volume only if a left-turn lane exists.

TABLE 5A

LEFT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

(If the left-turn volume exceeds the table value a left -turn lane is needed)

141

66 + 72 = 138

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	250	180	140	110	80	70
150 - 199	200	140	105	90	70	60
200 - 249	160		5	75	65	55
250 - 299	130		5	65	60	50
300 - 349	110		0	60	55	45
350 - 399	100		5	55	50	40
400 - 449	90		0	50	45	35
450 - 499	80		5	45	40	30
500 - 549	70		5	35	35	25
550 - 599	65		0	35	30	25
600 - 649	60	45	35	30	25	25
650 - 699	55	35	35	30	25	20
700 - 749	50	35	30	25	20	20
750 or More	45	35	25	25	20	20

North Ruggles Ferry Pike at Road "A"

2028 Projected PM EB Left Turns = 122

Left Turn Lane NOT Warranted

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	=/ >600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	25	25
350 - 399	40	35	30	25	25	20
400 - 449	35	30	30	25	20	20
450 - 499	30	25	25	20	20	20
500 - 549	25	25	20	20	20	15
550 - 599	25	20	20	20	20	15
600 - 649	25	20	20	20	20	15
650 - 699	20	20	20	20	20	15
700 - 749	20	20	20	15	15	15
750 or More	20	20	20	15	15	15

* Or through volume only if a right-turn lane exists

TABLE 5B

RIGHT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

72

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25						
25 - 49						
50 - 99						
100 - 149						
150 - 199						
200 - 249						Yes
250 - 299					Yes	Yes
300 - 349				Yes	Yes	Yes
350 - 399				Yes	Yes	Yes
400 - 449				Yes	Yes	Yes
450 - 499		Yes	Yes	Yes	Yes	Yes
500 - 549		Yes	Yes	Yes	Yes	Yes
550 - 599	Yes	Yes	Yes	Yes	Yes	Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

North Ruggles Ferry Pike at Road "A"

2028 Projected PM WB Right Turns = 66

Right Turn Lane NOT Warranted

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25						
25 - 49					Yes	Yes
50 - 99				Yes	Yes	Yes
100 - 149			Yes	Yes	Yes	Yes
150 - 199		Yes	Yes	Yes	Yes	Yes
200 - 249	Yes	Yes	Yes	Yes	Yes	Yes
250 - 299	Yes	Yes	Yes	Yes	Yes	Yes
300 - 349	Yes	Yes	Yes	Yes	Yes	Yes
350 - 399	Yes	Yes	Yes	Yes	Yes	Yes
400 - 449	Yes	Yes	Yes	Yes	Yes	Yes
450 - 499	Yes	Yes	Yes	Yes	Yes	Yes
500 - 549	Yes	Yes	Yes	Yes	Yes	Yes
550 - 599	Yes	Yes	Yes	Yes	Yes	Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

* Or through volume only if a left-turn lane exists.

TABLE 5A

LEFT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

(If the left-turn volume exceeds the table value a left -turn lane is needed)

105

20 + 62 = 82

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149 150 - 199	250 200	180 140	140 105	110 90	80 70	70 60
200 - 249 250 - 299	160 130			75 65	65 60	55 50
300 - 349 350 - 399	110 100			60 55	55 50	45 40
400 - 449 450 - 499	90 80			50 45	45 40	35 30
500 - 549 550 - 599	70 65			35 35	35 30	25 25
600 - 649 650 - 699	60 55	45 35	35 35	30 30	25 25	25 20
700 - 749 750 or More	50 45	35 35	30 25	25 25	20 20	20 20

North Ruggles Ferry Pike at Blake Lane/ Road "Q"

2028 Projected AM EB Left Turns = 10

Left Turn Lane NOT Warranted

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	=/ >600
100 - 149 150 - 199	70 60	60 55	50 45	45 40	40 35	35 30
200 - 249 250 - 299	55 50	50 45	40 35	35 30	30 30	30 30
300 - 349 350 - 399	45 40	40 35	35 30	30 25	25 25	25 20
400 - 449 450 - 499	35 30	30 25	30 25	25 20	20 20	20 20
500 - 549 550 - 599	25 25	25 20	20 20	20 20	20 20	15 15
600 - 649 650 - 699	25 20	20 20	20 20	20 20	20 20	15 15
700 - 749 750 or More	20 20	20 20	20 20	15 15	15 15	15 15

* Or through volume only if a right-turn lane exists

TABLE 5B

RIGHT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

RIGHT-TURN VOLUME	62 THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25 25 - 49 50 - 99						
100 - 149 150 - 199						
200 - 249 250 - 299					Yes	Yes Yes
300 - 349 350 - 399			es	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499		Yes	es Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

North Ruggles Ferry Pike at Blake Lane/ Road "Q"

2028 Projected AM WB Right Turns = 20

Right Turn Lane NOT Warranted

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25 25 - 49 50 - 99				Yes	Yes Yes	Yes Yes
100 - 149 150 - 199		Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
200 - 249 250 - 299	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
300 - 349 350 - 399	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
400 - 449 450 - 499	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
500 - 549 550 - 599	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

* Or through volume only if a left-turn lane exists.

TABLE 5A

LEFT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

(If the left-turn volume exceeds the table value a left -turn lane is needed)

138

37 + 117 = 154

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	100 - 149	150 - 199	200 - 249	250 - 299	300 - 349	350 - 399
100 - 149	200	180	140	110	80	70
150 - 199	200	140	105	90	70	60
200 - 249	160		85	75	65	55
250 - 299	130		75	65	60	50
300 - 349	110		70	60	55	45
350 - 399	100		65	55	50	40
400 - 449	90		60	50	45	35
450 - 499	80		55	45	40	30
500 - 549	70		45	35	35	25
550 - 599	65		40	35	30	25
600 - 649	60	45	35	30	25	25
650 - 699	55	35	35	30	25	20
700 - 749	50	35	30	25	20	20
750 or More	45	35	25	25	20	20

North Ruggles Ferry Pike at Blake Lane/ Road "Q"

2028 Projected PM EB Left Turns = 68

Left Turn Lane NOT Warranted

OPPOSING VOLUME	THROUGH VOLUME PLUS RIGHT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 599	=/ >600
100 - 149	70	60	50	45	40	35
150 - 199	60	55	45	40	35	30
200 - 249	55	50	40	35	30	30
250 - 299	50	45	35	30	30	30
300 - 349	45	40	35	30	25	25
350 - 399	40	35	30	25	25	20
400 - 449	35	30	30	25	20	20
450 - 499	30	25	25	20	20	20
500 - 549	25	25	20	20	20	15
550 - 599	25	20	20	20	20	15
600 - 649	25	20	20	20	20	15
650 - 699	20	20	20	20	20	15
700 - 749	20	20	20	15	15	15
750 or More	20	20	20	15	15	15

* Or through volume only if a right-turn lane exists

TABLE 5B

RIGHT-TURN LANE VOLUME THRESHOLDS FOR TWO-LANE ROADWAYS WITH A PREVAILING SPEED OF 36 TO 45 MPH

117

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	<100	100 - 199	200 - 249	250 - 299	300 - 349	350 - 399
Fewer Than 25						
25 - 49						
50 - 99						
100 - 149						
150 - 199						
200 - 249						Yes
250 - 299					Yes	Yes
300 - 349				Yes	Yes	Yes
350 - 399				Yes	Yes	Yes
400 - 449				Yes	Yes	Yes
450 - 499				Yes	Yes	Yes
500 - 549		Yes	Yes	Yes	Yes	Yes
550 - 599	Yes	Yes	Yes	Yes	Yes	Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

North Ruggles Ferry Pike at Blake Lane/ Road "Q"

2028 Projected PM WB Right Turns = 37

Right Turn Lane NOT Warranted

RIGHT-TURN VOLUME	THROUGH VOLUME PLUS LEFT-TURN VOLUME *					
	350 - 399	400 - 449	450 - 499	500 - 549	550 - 600	+ / > 600
Fewer Than 25						
25 - 49					Yes	Yes
50 - 99				Yes	Yes	Yes
100 - 149			Yes	Yes	Yes	Yes
150 - 199		Yes	Yes	Yes	Yes	Yes
200 - 249	Yes	Yes	Yes	Yes	Yes	Yes
250 - 299	Yes	Yes	Yes	Yes	Yes	Yes
300 - 349	Yes	Yes	Yes	Yes	Yes	Yes
350 - 399	Yes	Yes	Yes	Yes	Yes	Yes
400 - 449	Yes	Yes	Yes	Yes	Yes	Yes
450 - 499	Yes	Yes	Yes	Yes	Yes	Yes
500 - 549	Yes	Yes	Yes	Yes	Yes	Yes
550 - 599	Yes	Yes	Yes	Yes	Yes	Yes
600 or More	Yes	Yes	Yes	Yes	Yes	Yes

* Or through volume only if a left-turn lane exists.

APPENDIX I

MUTCD TRAFFIC SIGNAL WARRANT WORKSHEETS

Traffic Signal Warrant Analysis

Project Name	**Innsbruck Farms Subdivision**
Project/File #	**#2016**
Scenario	**2021 - Existing Traffic Volumes (+20%)**

Intersection Information	
Major Street Name	Asheville Highway
North/South or East/West	E/W
Speed Limit > 40 mph	Yes
# of Approach Lanes	2 or more
% of Right Turn Traffic to Include	100%
Minor Street Name	North Ruggles Ferry Pike
# of Approach Lanes	1
% of Right Turn Traffic to Include	100%
Isolated Community < 10,000 pop	No

Additional Warrants to Consider	
Warrant 3, Peak Hour (A - Volume and Delay)	No
All-Way Stop Warrant	No

Traffic Signal Warrant Analysis

Asheville Highway (Major Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	124	595	2	
8 - 9 AM	50	486	7	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	71	570	17	
12 - 1 PM	79	638	11	
1 - 2 PM				
2 - 3 PM	143	773	16	
3 - 4 PM	151	1073	22	
4 - 5 PM	150	1309	18	
5 - 6 PM	157	1357	2	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			7,821	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	0	1,355	8	
8 - 9 AM	0	937	2	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	2	666	2	
12 - 1 PM	6	703	4	
1 - 2 PM				
2 - 3 PM	4	731	1	
3 - 4 PM	4	814	6	
4 - 5 PM	1	892	11	
5 - 6 PM	4	898	4	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			7,055	0

North Ruggles Ferry Pike (Minor Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	0	0	0	
8 - 9 AM	0	1	1	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	8	0	7	
12 - 1 PM	4	0	6	
1 - 2 PM				
2 - 3 PM	5	0	6	
3 - 4 PM	7	0	11	
4 - 5 PM	5	1	7	
5 - 6 PM	5	0	2	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			76	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	4	0	188	
8 - 9 AM	1	2	109	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	0	0	42	
12 - 1 PM	0	0	70	
1 - 2 PM				
2 - 3 PM	0	0	104	
3 - 4 PM	0	0	91	
4 - 5 PM	0	1	78	
5 - 6 PM	1	0	74	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			765	0

Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Innsbruck Farms Subdivision
Project/File #	#2016
Scenario	2021 - Existing Traffic Volumes (+20%)

Intersection Information			
Major Street (E/W Road)	Asheville Highway	Minor Street (N/S Road)	North Ruggles Ferry Pike
Analyzed with	2 or more approach lanes	Analyzed with	1 Approach Lane
Total Approach Volume	14876 vehicles	Total Approach Volume	841 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	0 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Asheville Highway

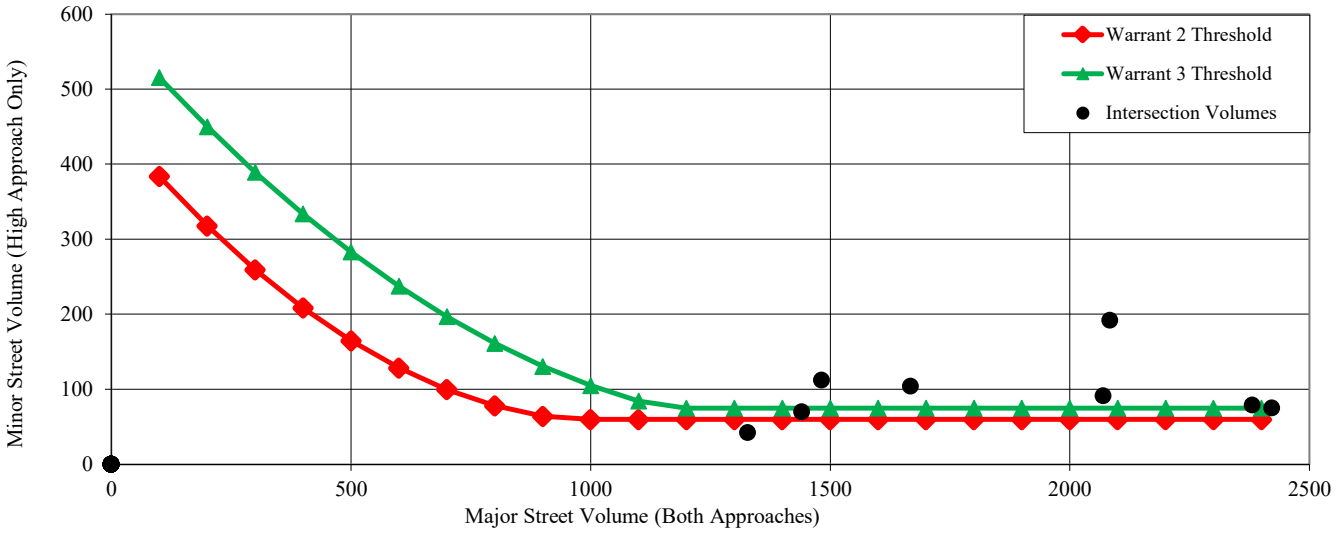
Warrant 1, Eight Hour Vehicular Volume			
	Condition A	**Condition B**	**Condition A+B***
Condition Satisfied?	**Not satisfied**	**Not satisfied**	**Not satisfied**
Required values reached for	2 hours	7 hours	4 (Cond. A) & 8 (Cond. B)
Criteria - Major Street (veh/hr)	420	630	336 (Cond. A) & 504 (Cond. B)
Criteria - Minor Street (veh/hr)	105	53	84 (Cond. A) & 42 (Cond. B)

* Should be applied only after an adequate trail of other alternatives that could cause less delay and inconvenience to traffic has failed to solve the traffic problems.

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	**Satisfied**
Required values reached for	7 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
	Condition A	**Condition B**
Condition Satisfied?	**Not Examined**	**Satisfied**
Required values reached for		6 hours
Criteria - Total Approach Volume (veh in one hour)		See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)		
Criteria - Minor Street High Side Delay (veh-hrs)		

Figure 4C-2 (Warrant 2 - 70% Factor) & Figure 4C-4 (Warrant 3 - 70% Factor)



Traffic Signal Warrant Analysis

Project Name	**Innsbruck Farms Subdivision**
Project/File #	**#2016**
Scenario	**2021 - Existing Traffic Volumes (+20%)**

Intersection Information	
Major Street Name	Andrew Johnson Highway
North/South or East/West	N/S
Speed Limit > 40 mph	Yes
# of Approach Lanes	2 or more
% of Right Turn Traffic to Include	100%
Minor Street Name	North Ruggles Ferry Pike (West Side)
# of Approach Lanes	1
% of Right Turn Traffic to Include	100%
Isolated Community < 10,000 pop	No

Additional Warrants to Consider	
Warrant 3, Peak Hour (A - Volume and Delay)	Yes
All-Way Stop Warrant	No

Traffic Signal Warrant Analysis

Andrew Johnson Highway (Major Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	5	439	0	
8 - 9 AM	5	420	0	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	11	456	0	
12 - 1 PM	17	511	2	
1 - 2 PM				
2 - 3 PM	12	586	2	
3 - 4 PM	16	918	0	
4 - 5 PM	17	1073	1	
5 - 6 PM	11	1180	0	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			5,682	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	0	1,072	12	
8 - 9 AM	4	678	13	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	7	508	14	
12 - 1 PM	11	552	11	
1 - 2 PM				
2 - 3 PM	7	613	16	
3 - 4 PM	12	650	25	
4 - 5 PM	12	706	25	
5 - 6 PM	6	706	29	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			5,689	0

North Ruggles Ferry Pike (West Side) (Minor Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	28	0	23	
8 - 9 AM	30	1	7	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	7	2	4	
12 - 1 PM	14	2	11	
1 - 2 PM				
2 - 3 PM	19	1	12	
3 - 4 PM	24	4	12	
4 - 5 PM	31	2	13	
5 - 6 PM	36	1	14	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			298	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	0	0	0	
8 - 9 AM	1	0	2	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	7	2	5	
12 - 1 PM	4	1	7	
1 - 2 PM				
2 - 3 PM	2	1	12	
3 - 4 PM	0	2	16	
4 - 5 PM	5	1	12	
5 - 6 PM	5	2	16	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			103	0

Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Innsbruck Farms Subdivision
Project/File #	#2016
Scenario	2021 - Existing Traffic Volumes (+20%)

Intersection Information			
Major Street (N/S Road)	Andrew Johnson Highway	Minor Street (E/W Road)	North Ruggles Ferry Pike (West Side)
Analyzed with	2 or more approach lanes	Analyzed with	1 Approach Lane
Total Approach Volume	11371 vehicles	Total Approach Volume	401 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	0 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Andrew Johnson Highway

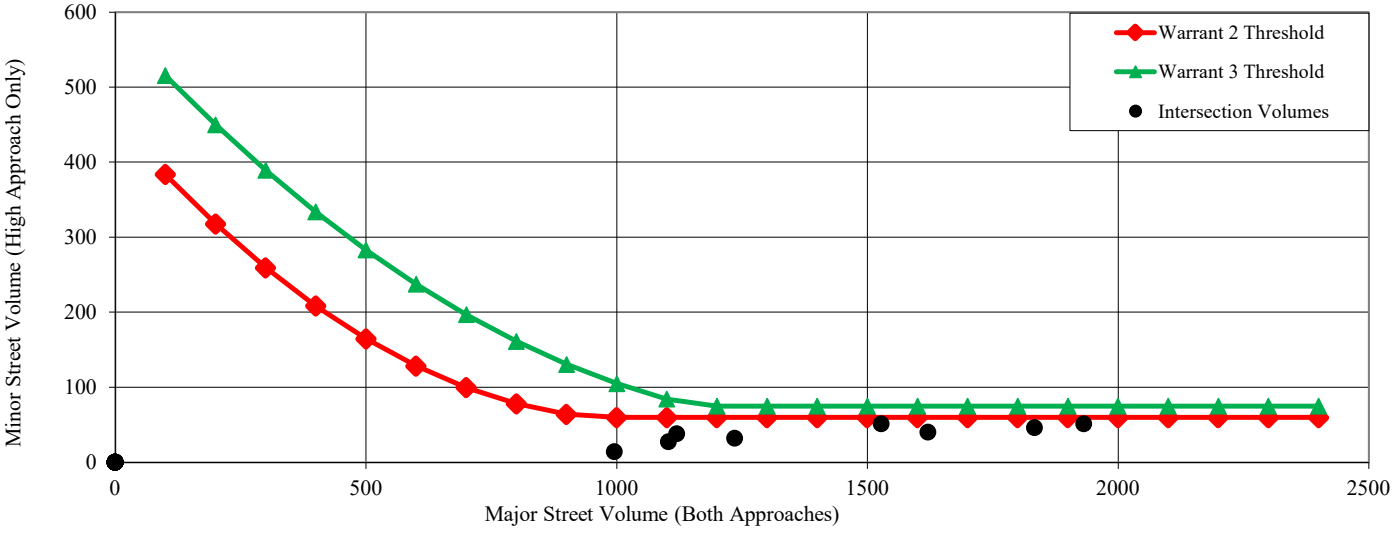
Warrant 1, Eight Hour Vehicular Volume			
	Condition A	**Condition B**	**Condition A+B***
Condition Satisfied?	**Not satisfied**	**Not satisfied**	**Not satisfied**
Required values reached for	0 hours	0 hours	0 (Cond. A) & 3 (Cond. B)
Criteria - Major Street (veh/hr)	420	630	336 (Cond. A) & 504 (Cond. B)
Criteria - Minor Street (veh/hr)	105	53	84 (Cond. A) & 42 (Cond. B)

* Should be applied only after an adequate trail of other alternatives that could cause less delay and inconvenience to traffic has failed to solve the traffic problems.

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	**Not satisfied**
Required values reached for	0 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
	Condition A	**Condition B**
Condition Satisfied?	**Satisfied**	**Not Satisfied**
Required values reached for	799 total, 150 minor, 6.3 delay	0 hours
Criteria - Total Approach Volume (veh in one hour)	650	See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)	150	
Criteria - Minor Street High Side Delay (veh-hrs)	5	

Figure 4C-2 (Warrant 2 - 70% Factor) & Figure 4C-4 (Warrant 3 - 70% Factor)



Traffic Signal Warrant Analysis

Project Name	**Innsbruck Farms Subdivision**
Project/File #	**#2016**
Scenario	**2022 - Projected Traffic Volumes (with Project)**

Intersection Information	
Major Street Name	Andrew Johnson Highway
North/South or East/West	N/S
Speed Limit > 40 mph	Yes
# of Approach Lanes	2 or more
% of Right Turn Traffic to Include	100%
Minor Street Name	North Ruggles Ferry Pike (West Side)
# of Approach Lanes	1
% of Right Turn Traffic to Include	100%
Isolated Community < 10,000 pop	No

Additional Warrants to Consider	
Warrant 3, Peak Hour (A - Volume and Delay)	No
All-Way Stop Warrant	No

Traffic Signal Warrant Analysis

Andrew Johnson Highway (Major Street) Volume

Northbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	7	466	0	
8 - 9 AM	7	426	0	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	13	463	0	
12 - 1 PM	19	519	2	
1 - 2 PM				
2 - 3 PM	15	595	2	
3 - 4 PM	19	932	0	
4 - 5 PM	21	1089	1	
5 - 6 PM	15	1198	0	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			5,809	0

Southbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	0	1,088	17	
8 - 9 AM	4	688	18	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	7	516	19	
12 - 1 PM	11	560	16	
1 - 2 PM				
2 - 3 PM	7	622	23	
3 - 4 PM	12	660	33	
4 - 5 PM	12	717	34	
5 - 6 PM	6	717	39	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			5,826	0

North Ruggles Ferry Pike (West Side) (Minor Street) Volume

Eastbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	64	0	50	
8 - 9 AM	63	1	31	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	42	2	26	
12 - 1 PM	54	2	36	
1 - 2 PM				
2 - 3 PM	50	1	32	
3 - 4 PM	60	4	34	
4 - 5 PM	73	2	39	
5 - 6 PM	83	1	43	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			793	0

Westbound Volume by Hour				
Time	Left Turns	Through	Right Turns	Peds/Bikes
12 - 1 AM				
1 - 2 AM				
2 - 3 AM				
3 - 4 AM				
4 - 5 AM				
5 - 6 AM				
6 - 7 AM				
7 - 8 AM	0	0	0	
8 - 9 AM	1	0	2	
9 - 10 AM				
10 - 11 AM				
11 - 12 PM	8	2	6	
12 - 1 PM	4	1	8	
1 - 2 PM				
2 - 3 PM	2	1	13	
3 - 4 PM	0	2	18	
4 - 5 PM	6	1	13	
5 - 6 PM	6	2	18	
6 - 7 PM				
7 - 8 PM				
8 - 9 PM				
9 - 10 PM				
10 - 11 PM				
11 - 12 AM				
Total Vehicles (unadjusted)			114	0

Traffic Signal Warrant Analysis

Warrants 1 - 3 (Volume Warrants)

Project Name	Innsbruck Farms Subdivision
Project/File #	#2016
Scenario	2022 - Projected Traffic Volumes (with Project)

Intersection Information			
Major Street (N/S Road)	Andrew Johnson Highway	Minor Street (E/W Road)	North Ruggles Ferry Pike (West Side)
Analyzed with	2 or more approach lanes	Analyzed with	1 Approach Lane
Total Approach Volume	11635 vehicles	Total Approach Volume	907 vehicles
Total Ped/Bike Volume	0 crossings	Total Ped/Bike Volume	0 crossings
Right turn reduction of	0 percent applied	Right turn reduction of	0 percent applied

Reduction applied to warrant thresholds due to high speed on Andrew Johnson Highway

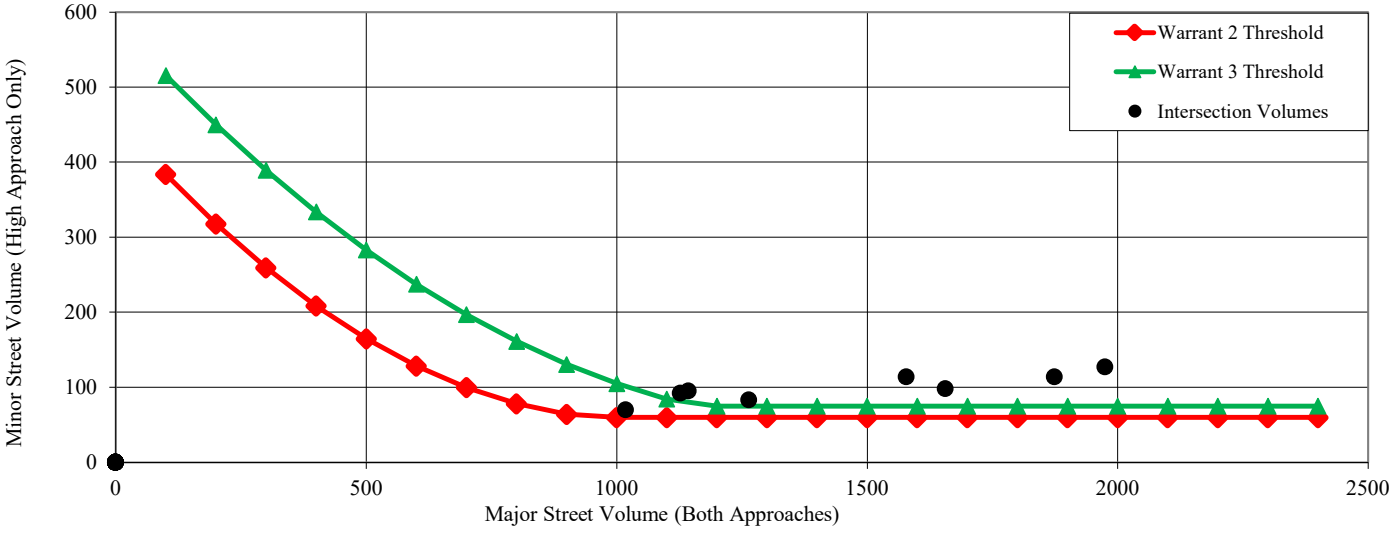
Warrant 1, Eight Hour Vehicular Volume			
	Condition A	**Condition B**	**Condition A+B***
Condition Satisfied?	**Not satisfied**	**Satisfied**	**Not satisfied**
Required values reached for	3 hours	8 hours	6 (Cond. A) & 8 (Cond. B)
Criteria - Major Street (veh/hr)	420	630	336 (Cond. A) & 504 (Cond. B)
Criteria - Minor Street (veh/hr)	105	53	84 (Cond. A) & 42 (Cond. B)

* Should be applied only after an adequate trail of other alternatives that could cause less delay and inconvenience to traffic has failed to solve the traffic problems.

Warrant 2, Four Hour Vehicular Volume	
Condition Satisfied?	**Satisfied**
Required values reached for	8 hours
Criteria	See Figure Below

Warrant 3, Peak Hour Vehicular Volume		
	Condition A	**Condition B**
Condition Satisfied?	**Not Examined**	**Satisfied**
Required values reached for		7 hours
Criteria - Total Approach Volume (veh in one hour)		See Figure Below
Criteria - Minor Street High Side Volume (veh in one hour)		
Criteria - Minor Street High Side Delay (veh-hrs)		

Figure 4C-2 (Warrant 2 - 70% Factor) & Figure 4C-4 (Warrant 3 - 70% Factor)



TRAFFIC SIGNAL WARRANTS

PROJECTED FUTURE VOLUMES IN YEAR 2022 WITH TRAFFIC GROWTH AND NEW SUBDIVISION TRAFFIC

	Andrew Johnson Highway			Private Driveway			Andrew Johnson Highway			North Ruggles Ferry Pike (West Side)			
TIME	SOUTHBOUND			WESTBOUND			NORTHBOUND			EASTBOUND			
BEGIN	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	LT	THRU	RT	
7:00 AM	0	205	0	0	0	0	0	58	0	2	0	2	Existing Volumes
7:15 AM	0	238	1	0	0	0	0	93	0	9	0	7	Existing Volumes
7:30 AM	0	267	1	0	0	0	1	119	0	6	0	9	Existing Volumes
7:45 AM	0	183	8	0	0	0	3	96	0	6	0	1	Existing Volumes
Sum	0	893	10	0	0	0	4	366	0	23	0	19	
+20% Increase	0	1072	12	0	0	0	5	439	0	28	0	23	Increase of 20% due to Covid
General Growth	0	16.08	0.18	0	0	0	0.075	6.585	0	0.42	0	0.345	Growth Rate of 1.5% for 1 year
Trips Generated 7-8 am	0	0	5	0	0	0	2	0	0	7	0	5	
Year 2022	0	1088	17	0	0	0	7	446	0	35	0	28	
8:00 AM	2	148	2	0	0	0	0	98	0	14	1	3	
8:15 AM	0	139	4	0	0	0	3	97	0	4	0	0	
8:30 AM	0	164	4	1	0	1	1	70	0	3	0	2	
8:45 AM	1	114	1	0	0	1	0	85	0	4	0	1	
Sum	3	565	11	1	0	2	4	350	0	25	1	6	
+20% Increase	4	678	13	1	0	2	5	420	0	30	1	7	
General Growth	0.06	10.17	0.195	0.015	0	0.03	0.075	6.3	0	0.45	0.015	0.105	
Trips Generated 8-9 am	0	0	5	0	0	0	2	0	0	6	0	5	
Year 2022	4	688	18	1	0	2	7	426	0	37	1	12	
11:00 AM	2	96	3	3	0	1	4	92	0	1	0	1	
11:15 AM	2	116	3	2	0	0	2	98	0	1	2	1	
11:30 AM	0	116	3	0	2	1	1	90	0	1	0	0	
11:45 AM	2	95	3	1	0	2	2	100	0	3	0	1	
Sum	6	423	12	6	2	4	9	380	0	6	2	3	
+20% Increase	7	508	14	7	2	5	11	456	0	7	2	4	
General Growth	0.105	7.62	0.21	0.105	0.03	0.075	0.165	6.84	0	0.105	0.03	0.06	
Trips Generated 11am-12 pm	0	0	4	0	0	0	2	0	0	7	0	4	
Year 2022	7	516	19	7	2	5	13	463	0	14	2	8	
12:00 PM	1	113	3	0	0	3	2	96	0	5	1	4	
12:15 PM	0	104	1	1	0	0	4	98	2	1	0	3	
12:30 PM	3	134	4	1	1	1	2	109	0	4	1	1	
12:45 PM	5	109	1	1	0	2	6	123	0	2	0	1	
Sum	9	460	9	3	1	6	14	426	2	12	2	9	
+20% Increase	11	552	11	4	1	7	17	511	2	14	2	11	
General Growth	0.165	8.28	0.165	0.06	0.015	0.105	0.255	7.665	0.03	0.21	0.03	0.165	
Trips Generated 12-1 pm	0	0	5	0	0	0	2	0	0	8	0	5	
Year 2022	11	560	16	4	1	7	19	519	2	22	2	16	
2:00 PM	3	122	3	2	1	1	2	108	0	6	0	3	
2:15 PM	1	145	5	0	0	3	1	104	1	4	1	2	
2:30 PM	1	124	3	0	0	4	4	120	1	3	0	3	
2:45 PM	1	120	2	0	0	2	3	156	0	3	0	2	
Sum	6	511	13	2	1	10	10	488	2	16	1	10	
+20% Increase	7	613	16	2	1	12	12	586	2	19	1	12	
General Growth	0.105	9.195	0.24	0.03	0.015	0.18	0.18	8.79	0.03	0.285	0.015	0.18	
Trips Generated 2-3 pm	0	0	6	0	0	0	3	0	0	6	0	4	
Year 2022	7	622	23	2	1	12	15	595	2	25	1	16	
3:00 PM	4	110	6	0	0	5	4	164	0	3	0	4	
3:15 PM	2	124	4	0	0	2	3	184	0	7	2	3	
3:30 PM	3	132	8	0	1	0	3	212	0	7	0	1	
3:45 PM	1	176	3	0	1	6	3	205	0	3	1	2	
Sum	10	542	21	0	2	13	13	765	0	20	3	10	
+20% Increase	12	650	25	0	2	16	16	918	0	24	4	12	
General Growth	0.18	9.75	0.375	0	0.03	0.24	0.24	13.77	0	0.36	0.06	0.18	
Trips Generated 3-4 pm	0	0	7	0	0	0	3	0	0	7	0	4	
Year 2022	12	660	33	0	2	16	19	932	0	31	4	16	
4:00 PM	1	148	5	1	0	4	3	223	0	4	0	3	
4:15 PM	3	145	7	2	1	5	5	205	1	8	1	3	
4:30 PM	1	143	7	0	0	1	4	208	0	8	0	4	
4:45 PM	5	152	2	1	0	0	2	258	0	6	1	1	
Sum	10	588	21	4	1	10	14	894	1	26	2	11	
+20% Increase	12	706	25	5	1	12	17	1073	1	31	2	13	
General Growth	0.18	10.59	0.375	0.075	0.015	0.18	0.255	16.095	0.015	0.465	0.03	0.195	
Trips Generated 4-5 pm	0	0	8	0	0	0	3	0	0	8	0	5	
Year 2022	12	717	34	5	1	12	21	1089	1	39	2	18	
5:00 PM	1	129	8	1	0	3	1	277	0	8	0	5	
5:15 PM	2	146	3	0	1	2	5	248	0	8	0	2	
5:30 PM	0	168	10	1	0	5	0	245	0	8	0	4	
5:45 PM	2	145	3	2	1	3	3	213	0	6	1	1	
Sum	5	588	24	4	2	13	9	983	0	30	1	12	
+20% Increase	6	706	29	5	2	16	11	1180	0	36	1	14	
General Growth	0.09	10.59	0.435	0.075	0.03	0.24	0.165	17.7	0	0.54	0.015	0.21	
Trips Generated 5-6 pm	0	0	9	0	0	0	4	0	0	9	0	6	
Year 2022	6	717	39	5	2	16	15	1198	0	45	1	20	

Assumed Growth Rate (%)= 1.5%
Number of years = 1
Year 2022

20% Increase due to Covid

Note:
The entering and exiting traffic volumes are estimated based on trip generation of the entire development, based on assumed amounts of entering and exiting traffic, assumed percentages of directional traffic, and the assumed percentage of trips based on time of day (from TDOT Table 4.2 in Traffic Design Manual)

Entire Development: 4,420 Daily Trips Generated from Subdivision 631.429 Additional Daily Trips per Year (4,420 trips/7 year)

	AM	PM
Traffic Movement Assumed Distribution:	45% from SB RT, 20% from NB LT 20% to EB LT, 15% to EB RT	25% from SB RT, 10% from NB LT 40% to EB LT, 25% to EB RT

Single-Family Detached Housing #210
Entering and Exiting %'s (from ITE Trip Generation):

		Directional Distribution Assumptions:		
25% Entering	AM Hours	45% from SB RT	20% to EB LT	
75% Exiting		20% from NB LT	15% to EB RT	
50% Entering	Mid-Day Hours	25% from SB RT	40% to EB LT	(PM D. Distribution)
50% Exiting		10% from NB LT	25% to EB RT	
63% Entering	PM Hours	25% from SB RT	40% to EB LT	
37% Exiting		10% from NB LT	25% to EB RT	

TDOT Traffic Engineering Office - Table 4.2 - TDOT Traffic Design Manual
Population Tier = A (Knoxville)
TDOT Region 1 Average for Arterial Facilities (Multi-Lane)

Time of Day	Percentage of Trips
7-8 am	7.20%
8-9 am	6.60%
11 am-Noon	5.52%
Noon-1 pm	6.11%
2-3 pm	6.39%
3-4 pm	7.34%
4-5 pm	8.48%
5-6 pm	9.50%
	57.14%

For example, 7-8 AM for SB Right Turns:
Volume = (4,420 Daily Trips * (1/7)) * 25% Entering * 45% Trips from SB RT * 7.20% Trips (at 7-8 AM)
Volume = 631.43 x .25 x .45 x .072
Volume = 5 Trips

This spreadsheet is used to estimate the future project hourly volumes to determine if a intersection will meet traffic signal warrants

APPENDIX J

RESPONSE LETTER TO ADDRESS REVIEW COMMENTS

AJAX ENGINEERING
CIVIL ENGINEERING / TRAFFIC ENGINEERING

11812 Black Road
Knoxville, Tennessee 37932
Phone (865) 556-0042
ajaxengineering@gmail.com

February 26, 2021

PROJECT NAME: Innsbruck Farms Subdivision TIS

TO: Knoxville-Knox County Planning

SUBJECT: TIS Comment Response Document for Innsbruck Farms Subdivision (3-SB-21-C)
Review Comments dated February 22, 2021

Dear Knoxville-Knox County Planning Staff:

The following comment response document is submitted to address comments dated February 22, 2021 and is included at the end of the revised report.

1. **Please show recommended improvements in figures for intersections within the Conclusions and Recommendations section.**
   a. **Has the skewed angle of N Ruggles Ferry Pike to AJ Highway been discussed with Knox County? Is there right-of-way to realign it?**

   Response: The revised report has included Figures 9a and 9b showing the recommendations for the intersections of Asheville Highway at North Ruggles Ferry Pike and Andrew Johnson Highway at North Ruggles Ferry Pike.

   The County has not been contacted regarding the skewed intersection of Andrew Johnson Highway at North Ruggles Ferry Pike. Based on property lines shown in KGIS (rough approximation), it does not appear that this skewed intersection could be re-aligned within the existing right-of-way, especially on the northwest and southwest corner of the intersection.

2. **During the Developer Review meeting on February 16, 2021, there was a concern for the two current access points for the subdivision, off Burris Road and a new access off N Ruggles Ferry Pike. The two access points are very close together and do not give**

proper circulation for the remainder of the subdivision. A connection to Blake Lane was mentioned and recommended by the review team as providing better ingress/egress for the other part of the subdivision as a secondary access point. This will need to be evaluated.

Response: The revised report has been updated to reflect this requested change. The revised site plan showing the abandonment a connection to Burris Road and changing to a Blake Lane connection has been fully incorporated in the revised report. Revisions reflecting these changes are made throughout the report.

3. **The review team has evaluated that there needs to be an eastbound right-turn lane at the intersection of N Ruggles Ferry Pike with AJ Highway. These right-turn volumes are minor approaches and they do not need to be included in the signal warrant justifications.**
   a. **At this intersection a signal is recommended. The crash history does not substantiate the need for a traffic signal at this time. You can keep this in the recommendations, but Knox County will not be requiring a signal due to this part of the development at this time. Another update to the study will be required if there are any additions to the subdivision.**

Response: An eastbound right-turn lane recommendation for North Ruggles Ferry Pike at Andrew Johnson Highway has been added to the report based on the review team's input. This additional recommendation has been added to the report in the Executive Summary section, the Conclusions and Recommendations section discussing the intersection, and in the new Figure 9b. The recommendation is made such that this right-turn lane should be added only if the intersection re-examination in the future warrants the construction. As suggested in the comment letter, the traffic signal recommendation for this intersection has been preserved in the report.

In addition to the requested revisions, other changes in the report include the following:

- Updated Title Page
- Updated Table of Contents
- Updated Page Footers
- Added "R3-2" to discussion regarding "No Left Turn" signage on Pages 2, 7, and 65
- Added Road "R" to discussion regarding future phases on Pages 3, 21, and 83
- Updated report to reflect the change from twenty internal roads to twenty-one on Pages 4, 20, 24, and 83
- Revised Photo Exhibits to include Blake Lane at North Ruggles Ferry Pike
- Updated report to reflect the change in the number of common areas from eight to nine on Page 20

- Updated report to reflect the change in the number of existing parcel areas from six to five on Page 21 and 23
- Updated Location Map on Figure 1
- Updated Table 1 to include Blake Lane
- As requested, a discussion regarding right-of-way width of North Ruggles Ferry Pike at Road "A" has been added on Page 59
- Updated Figures 2b, 3, 4b and 4d (site property boundary), 5b (site property boundary), 6b, 7a, 7b, 8a, and 8b
- Updated Tables 6, 7a, 7b, 7c, 7d,8b, and 9b
- Added Figures 9a and 9b (Summary of External Recommendations)
- Updated Internal Sign Locations on Page 83
- Updated Appendix F calculations
- Updated Appendix H calculations
- Added Appendix J to include this response letter

If you have any questions or further comments, please feel free to contact me at any time. I look forward to your review and approval.

Sincerely,

Ajax Engineering, LLC
Robert W. Jacks, P.E.

Ajax Engineering, LLC
11812 Black Road
Knoxville, TN 37932
ajaxengineering@gmail.com
© 2021 Ajax Engineering, LLC